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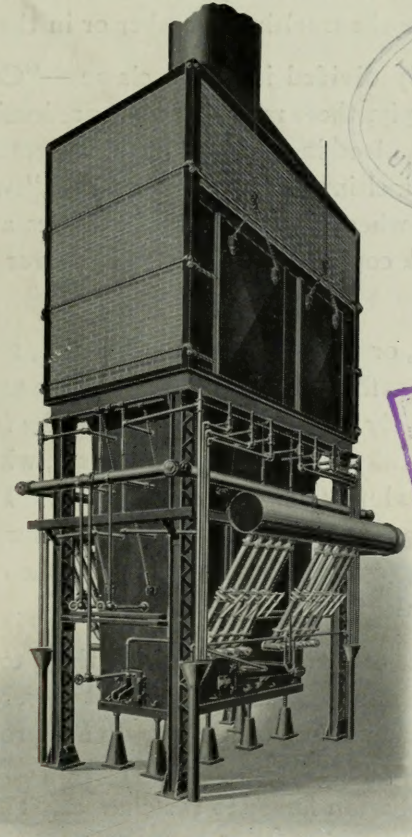
Allis-Chalmers
Manufacturing Company

Bulletin 1417A

Reprinted January 1921

Smelting Furnaces and Accessory Equipment

Plate No. 11943



Copper Furnace

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MILWAUKEE, WISCONSIN, U. S. A.

By Allis-Chalmers Mfg. Co.

SMELTING

INTRODUCTION

Smelting is that metallurgical process in which ores are melted or fused for the purpose of separating their valuable metal constituents from the gangue or worthless portions. It consists essentially in subjecting the ores, mixed with suitable fluxes and constituting a "charge," to the action of intense heat whereby the "charge" is rendered fluid; the gangue combining with the fluxes to form a slag or scoria while the valued metals combine to form an alloy or matte. The separation of the matte and the slag takes place, while the materials are in a molten condition, by reason of the difference in their specific gravities.

Smelting is performed either in a blast furnace where the fuel (coke or charcoal) is mixed with the charge, or in a reverberatory furnace in which the fuel (coal, gas or oil) is burned in a fire-box adjoining the smelting chamber or in the smelting chamber.

Smelting may be roughly divided into two classes—"Copper Smelting" and "Lead Smelting." As the terms imply, these mean that the predominating valuable metal in the charge is copper in the one and lead in the other. In lead smelting the valuable product is "lead bullion." In copper smelting, it is "copper matte," when sulphide ores are being treated, and "black copper" when oxide, or carbonate ores are being smelted. The lead bullion, copper matte or black copper, contains also whatever gold or silver was in the ores constituting the charge.

For smelting, the charge, or mixture of ores and fluxes, must be of such a composition that the resulting slag will be sufficiently liquid to allow the valued metal or its compounds to separate from the mass readily and to flow freely from the furnace. The slags produced in smelting consist mainly of silica, ferrous oxide and lime, with which there are frequently small quantities of zinc oxide, alumina and other materials. The amount of these materials in a slag is more of a commercial proposition than a metallurgical one, as the composition of a slag may be varied widely without seriously affecting the running of the furnace, or the extraction of the valued metals.

Custom smelters buy ores of many kinds, mixing them together in proper proportions to form furnace charges of the required composition and thereby making one ore the flux for another. Independent smelters, whose own mines do not produce ores of the composition required for fluxing purposes, endeavor to secure such ores from other sources, as otherwise they would have to add barren fluxes to the charge. These cost as much to smelt as ore and give no results beyond their fluxing powers. Conditions are, however, rarely so favorable that no barren fluxes need to be added. Limestone, iron ore, and, in some cases, silicious material, are nearly always necessary to make a charge. For this reason it is desirable to locate smelters in localities where these fluxes may be easily secured.

The fuel used in blast furnaces is coke or charcoal, or a mixture of the two. Coke is preferable, as it does not crush as readily as charcoal under the weight of the charge in the furnace shaft. The quantity of fuel required by a blast furnace depends upon the character of the ore to be treated, the nature of the fuel itself and the process of smelting involved. In modern lead smelting, the quantity of coke required is, on an average, about 12 to 14 per cent. of the weight of the charge. In copper smelting, from 8 per cent. to 18 per cent. coke is required.

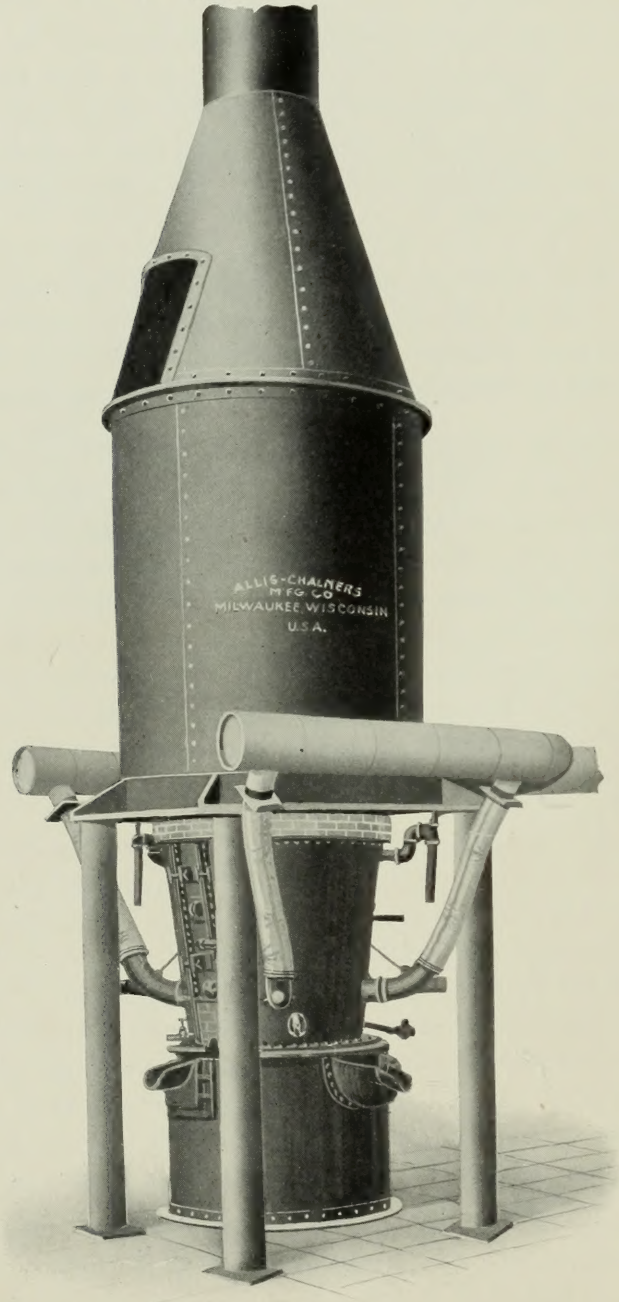
For reverberatory furnaces, coal, oil or gas may be used as fuel. The quantity required depends upon the character of the ore, the nature of the fuel itself and the design and size of the furnace. In large, modern reverberatory furnaces using ordinary pulverized bituminous coal, 300 to 400 pounds of fuel are used per ton of ore smelted.

An important advantage of smelting is that nearly all ores, when properly fluxed, can be treated by this process. The extraction of the valued metals in smelting depends principally upon the character of the ores, but is also largely dependent upon the man in charge of the plant. Ordinarily it is safe to figure that practically all of the gold, ninety-five per cent. of the silver and ninety per cent. or more of the lead or copper will be saved. The cost of smelting depends upon the character of the ore, the cost of coke and labor, the size of the plant and its equipment and arrangement. In some large plants, equipped with the most modern machinery and operating under very favorable conditions a cost as low as $1.25 per ton has been attained, while with small plants in remote localities, where fuel and labor are expensive, the cost will run up to $15.00 per ton or higher.

Success in smelting is primarily dependent upon having a plant equipped with the best and most modern machinery. The arrangement of the plant should be such that ample working room is provided around the furnaces. Rehandling of materials should be avoided as far as possible and hand labor eliminated wherever it is practicable to put in mechanical means for performing the work. A smelting plant should be carefully designed, and every condition that will influence the cost of operation should be carefully considered when the equipment is being decided upon and the plans made. It is often the case that a few additional dollars spent in equipment will mean the saving of thousands in operating expense. Even in a small plant a saving of but a few cents per ton of ore handled amounts to a considerable sum at the end of a year's run.

In the following pages modern machinery for lead and copper smelting is described and illustrated. Plants completely equipped with Allis-Chalmers machinery can be seen in operation in every State and Territory in this country where mining is followed. They are to be found in Mexico, Canada, Central and South America, Africa, China, Japan, Korea, Russia, Spain, India, Norway and in many other foreign countries. In fact, wherever there is even a pretense to modern methods in the mining or reduction of ores, Allis-Chalmers machinery may be found in operation.

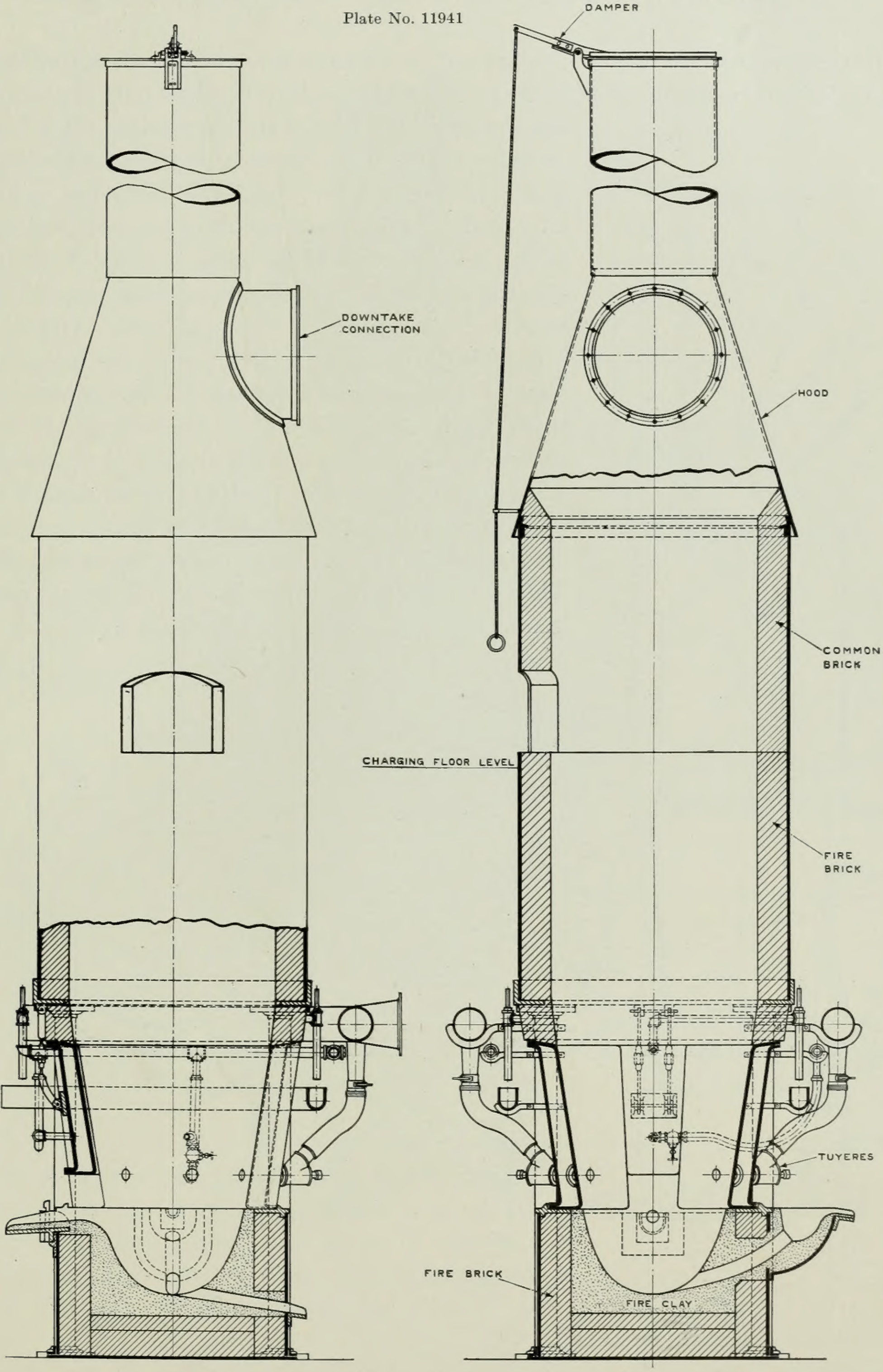
Plate No. 10343



Round Water Jacketed Blast Furnace, for Smelting Lead Ores. (See Plate 11941)

We make small lead smelting furnaces for remote districts and small mines. Built in various sizes, for 10 to 30 tons capacity per day of 24 hours. Inexpensive and efficient, also portable. Built sectional, for muleback transportation, if desired.

Plate No. 11941

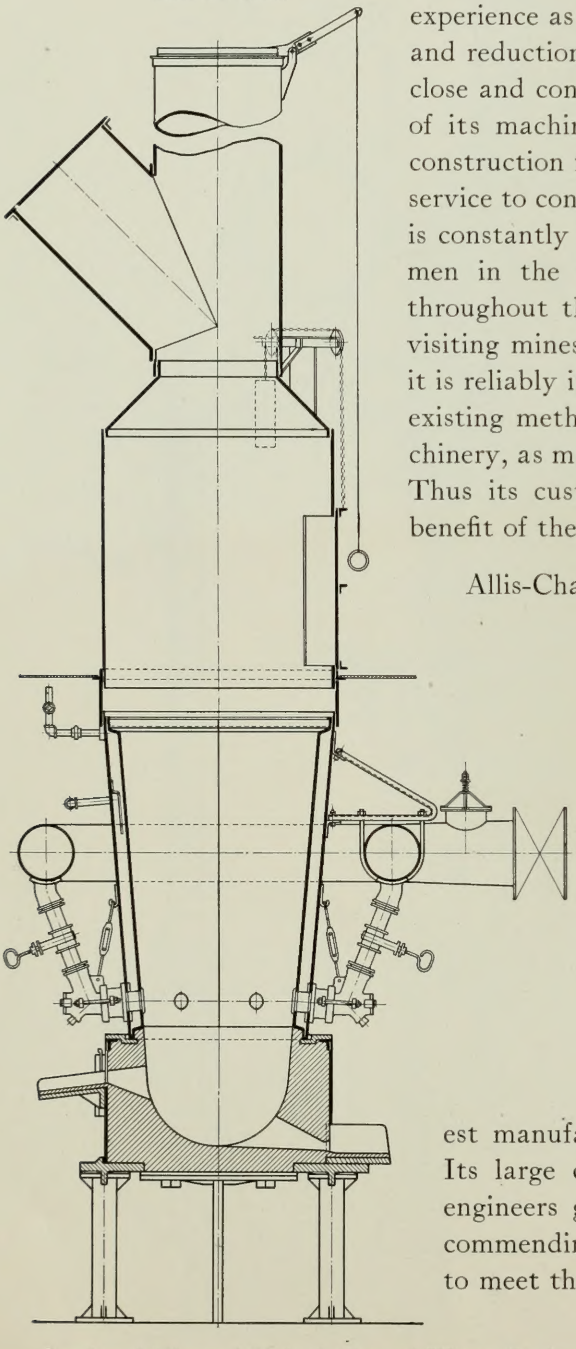


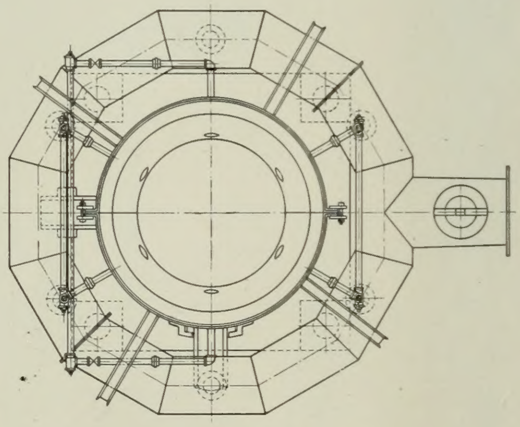
Sectional View of Round Water Jacketed Blast Furnace for Smelting Lead Ores.

In the construction of its machinery, this company uses the best of materials, and in its shops, which are equipped with the most modern tools, it employs only the most skillful mechanics. The designs are the result of some fifty year's experience as manufacturers of machinery for the mining and reduction of ores. Since the beginning, it has given close and continuous attention to the practical operation of its machinery, making such changes in designs and construction from time to time, as were proven in actual service to constitute real improvements. Moreover, as it is constantly in communication with the most successful men in the various branches of the mining industry throughout the world, and its representatives are daily visiting mines and metallurgical works in every country, it is reliably informed as to all successful departures from existing methods, and prepared to design such new machinery, as may be necessary to keep abreast of the times. Thus its customers, through the company, receive the benefit of the experience of the entire world.

Allis-Chalmers Manufacturing Company is the largest manufacturer of mining machinery in the world. Its large corps of specially trained and experienced engineers gives to each inquiry careful attention, recommending only such machinery as is best suited to meet the requirements of each case. All orders are

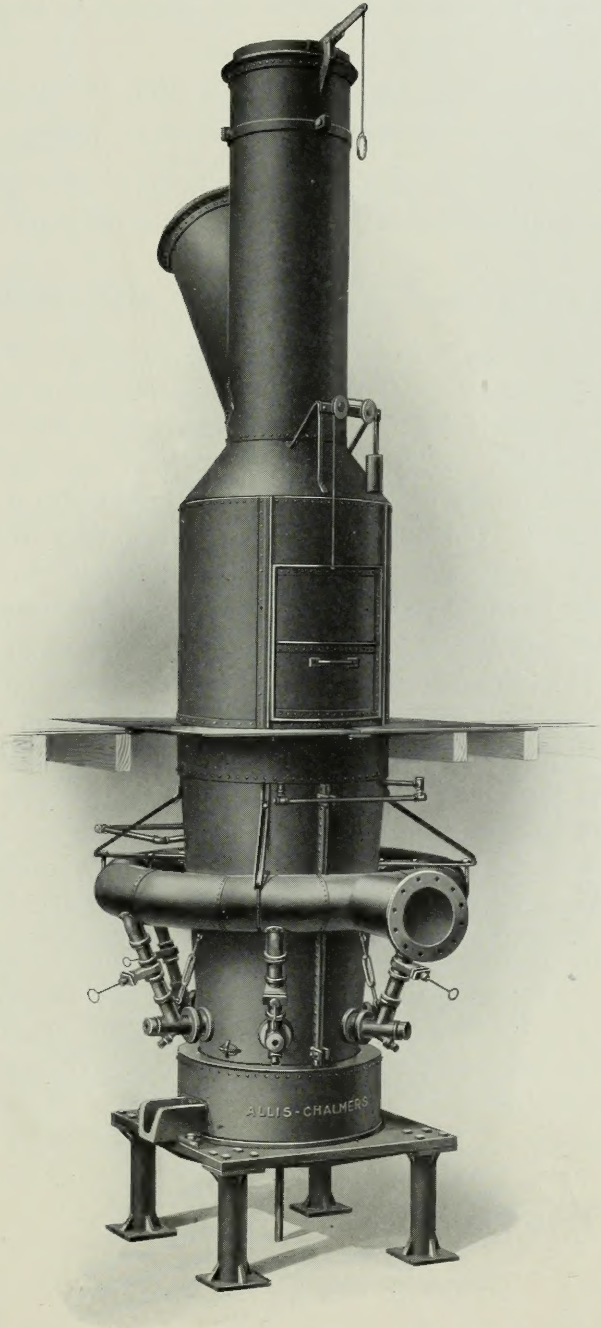
Plate No. 10525





Sectional View of 36 inch Round Water Jacketed Blast Furnace, for Smelting Copper Ores.

Plate No. 10523



36 inch Round Steel Water Jacketed Blast Furnace, for Smelting Copper Ores.

We make small copper smelting furnaces for remote districts and small mines. Built in various sizes, for 20 to 50 tons capacity per day of 24 hours. Inexpensive and efficient also portable. Built sectional, for muleback transportation, if desired.

carefully followed through the designing rooms and shops and inspected prior to shipment by men of long experience in the work.

Allis-Chalmers Manufacturing Company builds only the highest grade and most modern types of machinery. Its product is not excelled anywhere.

All Allis-Chalmers furnaces are erected completely in our shops prior to shipment and the parts are fitted and marked to facilitate re-erection at the place of installation.

BLAST FURNACES FOR LEAD SMELTING

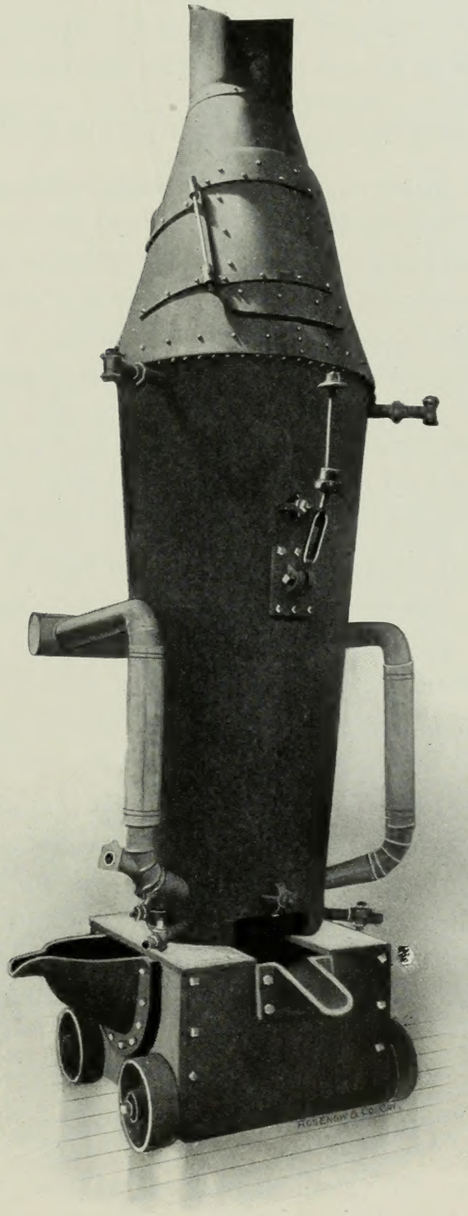
A modern blast furnace for lead smelting consists essentially of a brick shaft resting upon a suitable mantle frame carried by four columns at the corners of the furnace. Below this shaft is a set of steel water jackets, which form the smelting chamber, suitable openings being provided near the bottom of the side jackets for the tuyeres through which the blast is introduced. Below the jackets is a fire brick crucible encased in steel or cast iron plates and known as the "curb." The brick shaft may terminate at the charging floor, the downtake or flue for conducting away the gases connecting with the shaft just below the charging floor. The top of the shaft is covered and provided with openings for charging the furnace, or the shaft may extend above the feed floor, terminating in a stack extending through the roof of the building, suitable openings being provided in the sides of the shaft at the feed floor for charging. In the latter type of furnace the downtake connects with the shaft at some convenient point above the feed floor. The downtake in either case connects with the dust chamber, or flue, which leads the gases to the main stack of the plant. In the crucible the molten materials separate, the lead settling to the bottom and being removed through an inverted syphon passage provided in the brick work of the curb. The slag passes out through a tap hole at either one side or end of the furnace.

Large furnaces are built rectangular in shape. Small furnaces are made round. Allis-Chalmers Company makes round furnaces, 20 inches, 24 inches, 30 inches, 36 inches and 42 inches diameter inside of the jackets at the tuyere line, and rectangular furnaces of any size desired. The sizes of rectangular furnaces most used are 33 inches by 72 inches, 36 inches by 84 inches, 36 inches by 100 inches, 36 inches by 120 inches, 42 inches by 120 inches, 42 inches by 144 inches, 44 inches by 144 inches, 44 inches by 160 inches, 44 inches by 180 inches and 48 inches by 180 inches. All of the foregoing dimensions are measurements made inside of the jackets at the tuyere line.

20 INCH ROUND FURNACE

Plate 1334 shows our 20-inch Round Steel Water-Jacketed Blast Furnace, which may be used for either lead or copper ores. The jacket, made of steel plate with riveted and welded joints, is hung from the feed floor, to allow the removal of the curb without disturbing the remainder of the furnace. We furnish either a stationary or movable

Plate No. 1334



20 inch Round Steel Water Jacketed Blast Furnace.

curb with this furnace, as desired. The jacket of the furnace is surmounted by a steel hood provided with a door for charging the furnace and terminating in a short steel stack. This furnace was designed for use in college laboratories, and for small laboratories working up the by-products of refineries or sweepings from jeweler's shops and like work, where smelting is conducted on a small scale, and for such purposes it is extensively used.

ROUND WATER JACKETED LEAD FURNACES

Plate 10343 on page 4, shows our design of Standard Round Lead Furnaces. These are made in four sizes, viz: 24-inch, 30-inch, 36-inch and 42-inch. These furnaces consist of a curb made of steel plate, lined with fire brick upon which rests a set of steel water jackets. Above the jackets is a brick shaft, resting upon a mantle frame carried by four columns, and surrounded by a sheet steel casing, extending up to the feed floor. Covering the shaft is a cone-shaped steel hood provided at the charging floor with an opening for charging the furnace and terminating in a short steel stack to pass through the roof of the building. These furnaces are frequently provided with a downtake, connecting with the stack just above the hood for conducting the gases to a main dust flue. Plate 1969, on page 28, shows, on a large scale, the curb and jackets for the 36-inch size of these furnaces.

The favorite sizes of this type, are the 36-inch and 42-inch furnaces; the 24-inch and 30-inch furnaces are rarely used except in refineries and laboratories.

RECTANGULAR WATER JACKETED LEAD FURNACES

Plates 10341 and 10367 represent our latest type of water jacketed furnace designed for smelting lead ores.

The crucible or curb, is made of heavy steel or cast iron plates, resting upon a steel bottom plate. The end plates are strongly secured to the side plates and the entire crucible is securely bound together by means of binders on the outside. The curb is fitted with suitable lead well spout. On large lead furnaces, bronze water-cooled tapping jackets are provided, each fitted with a water cooled spout, for discharging the slag. On the smaller furnaces, we supply a cast iron water cooled tapping jacket with cast iron spout.

The water jackets are made of the best grade of flange steel, having either welded or riveted joints. They are rigidly braced between the front and back plates by means of our special stays, which are riveted to the outside plate and only bear against the inside plate. By this construction, no rivet heads appear anywhere on the inside plate of jackets. The upper part of the jackets is made higher at the back, than at the front, in order that air and steam cannot accumulate in the bend of the inner sheet. All jackets are provided at their sides with heavy steel lugs with bolts for binding them to the adjoining jackets, and the entire set of jackets, is bound together by strong steel binders encircling the jackets, or held in place by jackscrews resting against the mantle frames.

Suitable tuyere openings are provided in the side jackets near the bottom of the jacket. Tuyeres are seldom placed in the end jackets of modern lead furnaces. The tuyere boxes are of our special "individual" type, made up of cast iron with wood safety plug and removable cap to allow of barring the furnace. They are bolted rigidly to the back of the jackets and connected to the bustle pipe by light steel tubing. Each tuyere is controlled by a blast gate in the tuyere pipe, thereby giving the furnace operator perfect control of each tuyere.

The bustle piping is made of black steel or galvanized steel. It is provided with a main flanged nozzle for connecting it to the main blast pipe, and with connections for the tuyere pipes. The bustle piping is usually supported from the mantle frame or other beams.

A main water supply pipe for conducting cooling water to the jackets encircles the furnace, near the top of the jackets, and is provided with all necessary branches and connections to the jackets. Suitable means are also provided for taking care of discharge water from the jackets.

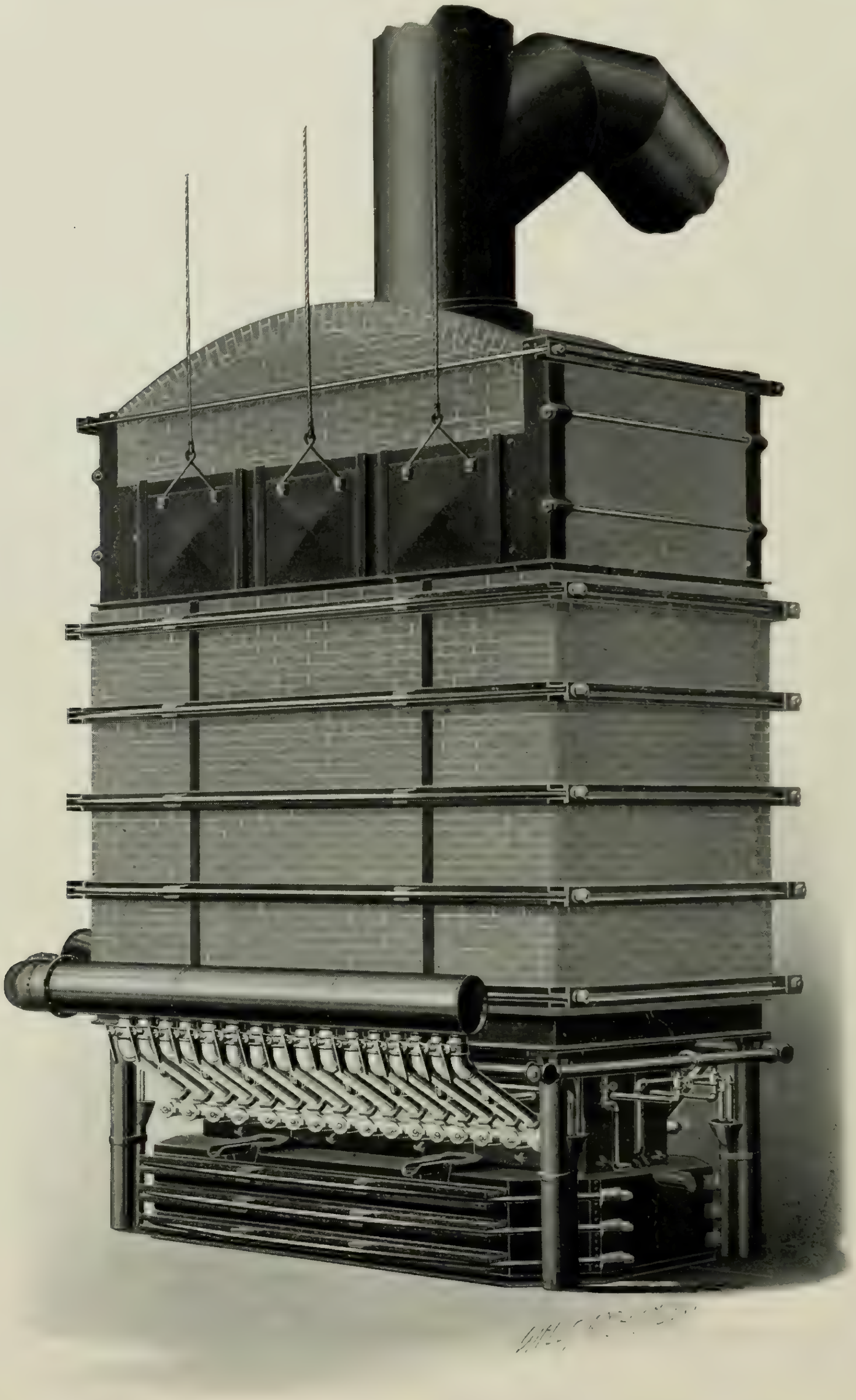
The brick shaft above the jackets is supported by a mantle frame built up of heavy steel "I" beams and channels. This is carried by cast iron or steel columns, at the corners of the furnace. A heavy cast iron deck plate rests upon the mantle frame, forming a base for the brick-work of the shaft. The shaft of the smaller furnaces, is bound on the outside by heavy corner binders tied to the opposite corner binders by heavy steel rods. The shaft on larger furnaces is bound by heavy steel channel frames, secured by suitable truss rods. For the corners of the brick-work, heavy angles are furnished. This reinforces the brick-work and avoids any side or end thrust which may be caused by the movement of the charge.

When the furnace is of the "hood type," the shaft extends about ten feet above the charging floor level and is covered by a brick arch or sheet steel hood terminating in a sheet steel stack extending up through the roof of the building with the downtake connecting at a suitable point in the hood or stack. In this style of furnace charging openings are provided at the sides of the shaft at the feed floor level. These openings are provided with counter-weighted steel doors. The stack is provided with a damper, which is kept closed, except when the furnace is being blown in, or out, of service.

LEAD FURNACE CAPACITY AND FUEL

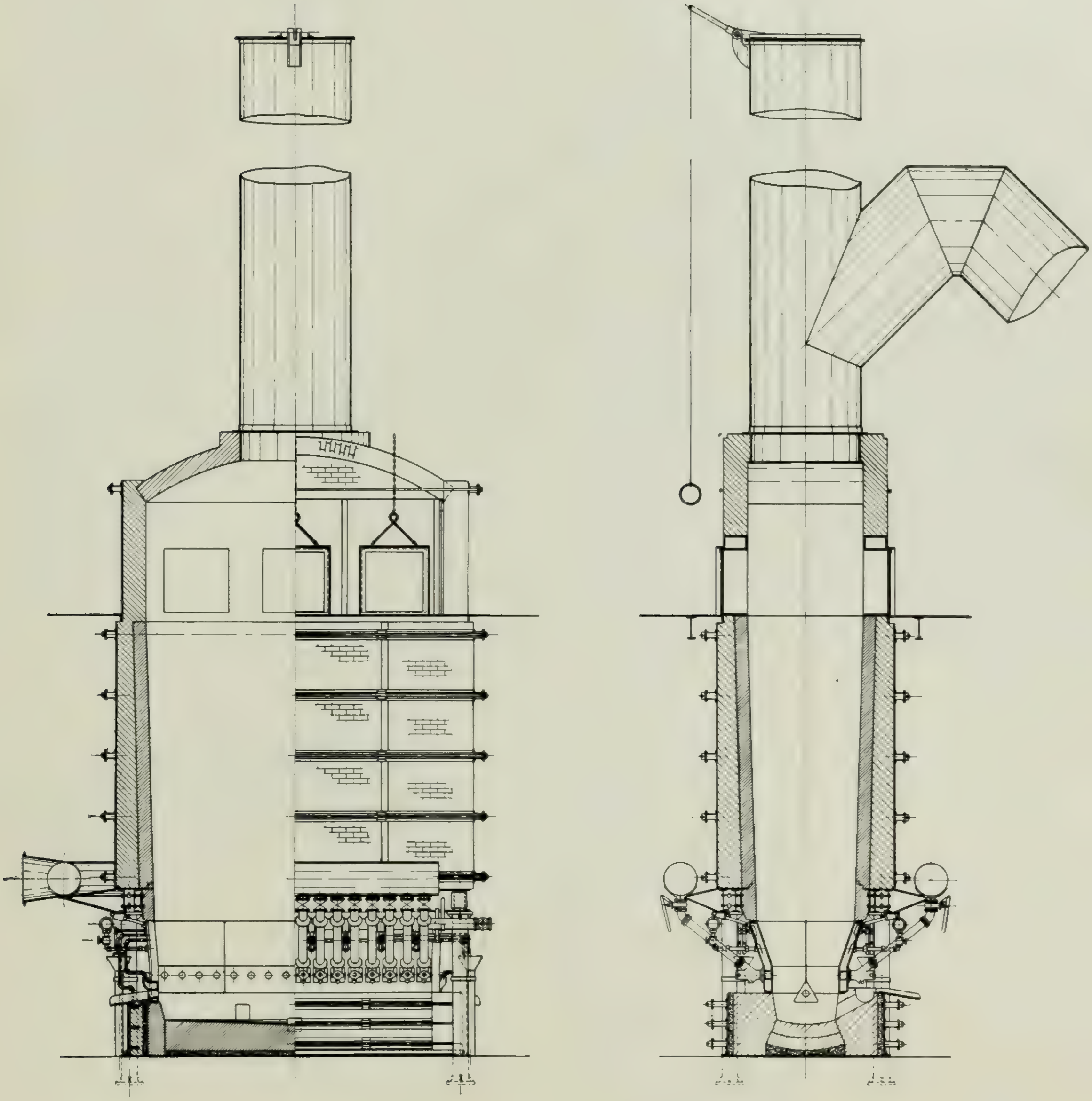
The capacity of a lead furnace depends chiefly upon the character of the ores treated, although much also depends upon the man in charge and upon the design of the furnace itself. Our furnaces are rated ordinarily at a capacity of about 3⅓ tons of charge per twenty-four hours, per square foot of area at tuyere level; that is, a 36-inch by 120-inch furnace is rated at 100 tons capacity per 24 hours. This capacity is generally exceeded, especially by large furnaces.

Plate No. 10341



44 by 180 inch Rectangular Water Jacketed Blast Furnace, for Smelting Lead Ores.

Plate No. 10367



Side Elevation

Sectional End Elevation

44 by 180 inch Rectangular Water Jacketed Blast Furnace, for Smelting Lead Ores.

The quantity of fuel required, also depends upon the above-mentioned conditions, and varies materially with the character of the fuel itself. In small lead furnaces using coke as much as 20 per cent. of the weight of the charge may be necessary, while with large furnaces as little as 10 per cent. is sufficient. A general average may be assumed, however, at from 12 per cent. to 14 per cent. of the charge. When charcoal is used a somewhat larger quantity will be required.

Coke is the most satisfactory fuel for blast furnaces, as, owing to the strength of its structure, it does not readily crush under the weight of the charge in furnace. Charcoal however is very satisfactory for small furnaces.

BLAST FURNACES FOR COPPER SMELTING

Blast furnaces for smelting copper ores are similar in general form to those used for lead smelting, but in detail they differ from them materially. The internal crucible is either quite shallow or is dispensed with entirely, as in the case of matting furnaces where the molten materials pass at once from the furnace into an external crucible known as the "settler" where the separation of the matte and slag takes place. The jackets are much higher than in lead furnaces, extending in many furnaces up to the charging floor. In this case, they are made in two tiers or sections. The tuyere boxes are of the rigid type and connected with the bustle pipe by light steel tubing. The mantle frame and supporting columns and the structure above the mantle frame are much the same as for lead furnaces. Large copper furnaces are built rectangular in shape; small furnaces round.

ROUND COPPER FURNACES

Our standard 36 inch round copper furnace is shown in plate 10523 on page 7. We make round furnaces in four sizes, viz., 24-inch, 36-inch, 42-inch and 48-inch. These are the diameters inside of the jackets at the tuyere line. The bottom of our 36-inch furnace consists of a heavy cast iron plate resting upon four short columns and having hinged drop doors under the bottom of the furnace shaft. The water-jacket is of steel plate with welded joints. Below the jacket is a sheet steel crucible curb made of steel plate. A sheet steel bustle pipe surrounds the jacket and has six openings connecting to seamless steel tubing, which connects to tuyeres. There are six cast iron individual tuyere boxes of our special design, each controlled by a blast gate in tuyere pipe. These valves give the operator perfect control of each tuyere. Above the jacket is a sheet steel hood of conical shape provided at the feed floor level with an opening for charging the furnace. The hood terminates in a steel stack passing up through the roof of the building.

These furnaces are used extensively, owing to their simple and durable construction, compactness of design and the facility with which they can be transported, erected and operated.

Plate No. 5566

SMALL SMELTING PLANTS INSTALLED IN ISOLATED PLACES

Plate No. 5564

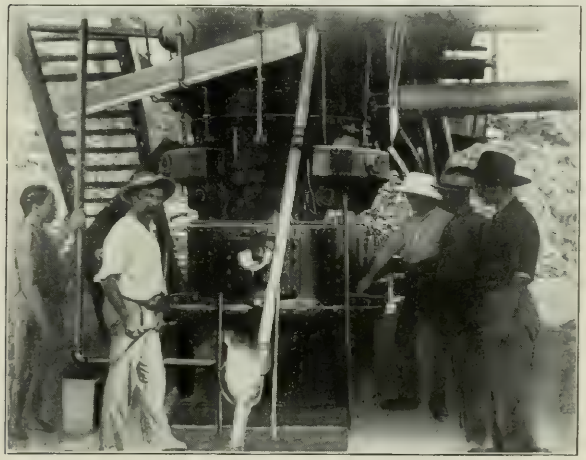
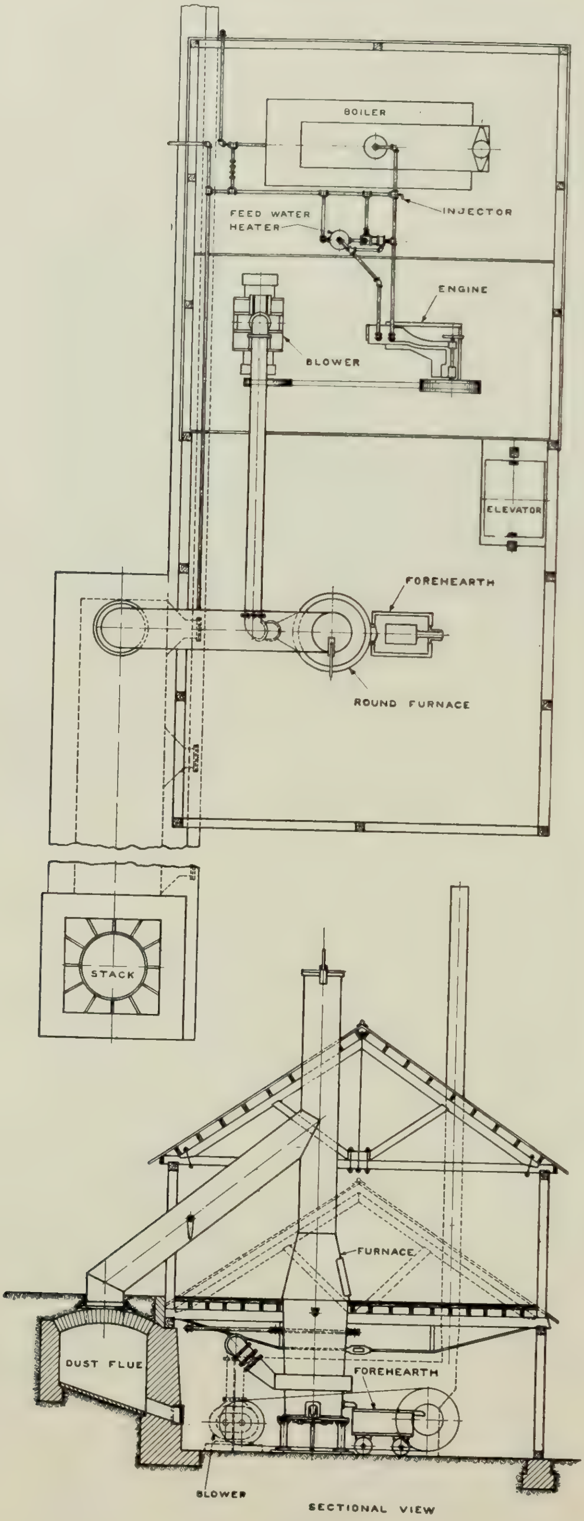


Plate No. 11942



General Arrangement of Small Smelting Plant for Copper Ores—Plan and Elevation
For Muleback Transportation, we are prepared to Sectionalize the Machinery

RECTANGULAR WATER JACKETED COPPER FURNACES

The furnace represented by Plates 10344 and 10486 is of our latest design in rectangular matting furnaces, but it can be modified when necessary to suit special conditions which may arise.

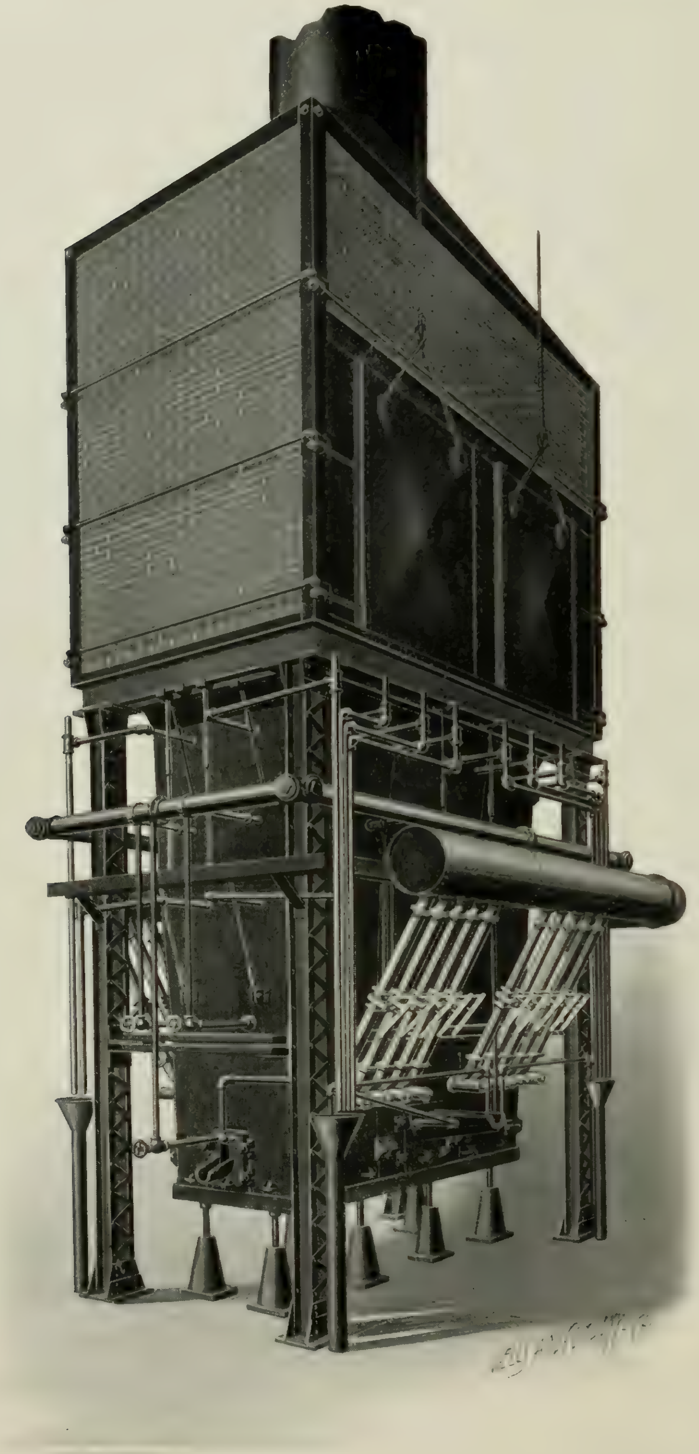
The bottom of this furnace is made of cast iron plates, heavily ribbed, bolted together and supported by jack screws or columns which rest upon the furnace foundation.

This type of furnace is made with either single or double tier of jackets to suit requirements. The jackets rest directly upon the bottom plate, but are hung from the mantle frame (or other beams) by suitable hangers, so that when the bottom plate is lowered, the jackets remain in position suspended from the beams. The jackets are made in sections, of best flange steel plate, having welded or riveted joints, and are flanged in such a manner that no rivets are exposed to the fire. Our jackets are stayed between the front and back sheets by our improved steel stays. No rivet heads appear anywhere on the front sheets of the jacket. The end jackets are provided with a recess at the base for a rectangular tapping jacket used for draining the furnace when blowing out of service. One side jacket is provided at its base with a recess for inserting a rectangular breast jacket, in front of which the trap-spout is set and through which the molten materials flow to the settler. Notwithstanding this, the arrangement is frequently reversed by placing the slag and matte jackets at the ends and the others at the sides. The end tapping jackets are usually made of cast iron. As they are not used often it does not require a more durable or more expensive material. The breast jacket and trap-spout are made of either silicon copper or of steel plate, as they are constantly in use and require very durable materials to give satisfactory service. All jackets are provided at their edges with strong lugs and bolts for securing them to adjoining jackets and the entire set is bound by steel "I" beams or channel binders on each side and end of the furnace, or they may be held in position by means of special jackscrews. All jackets are provided with inlet and outlet connections for cooling water, hand-holes at the base for cleaning and all other fixtures and fittings, complete.

The tuyere boxes are of our special "individual" type, made of cast iron with wood safety plug and removable cap to allow of barring the furnace. They are bolted rigidly to the back of the jackets and connected to the bustle pipe by light steel tubing. Each tuyere is controlled by a blast gate in the tuyere pipe thereby giving the furnace operator perfect control of each tuyere. The bustle pipe is of steel plate provided with a main flanged nozzle for connecting it with the main blast pipe and suitable nozzles on each leg for connecting the tuyere pipes.

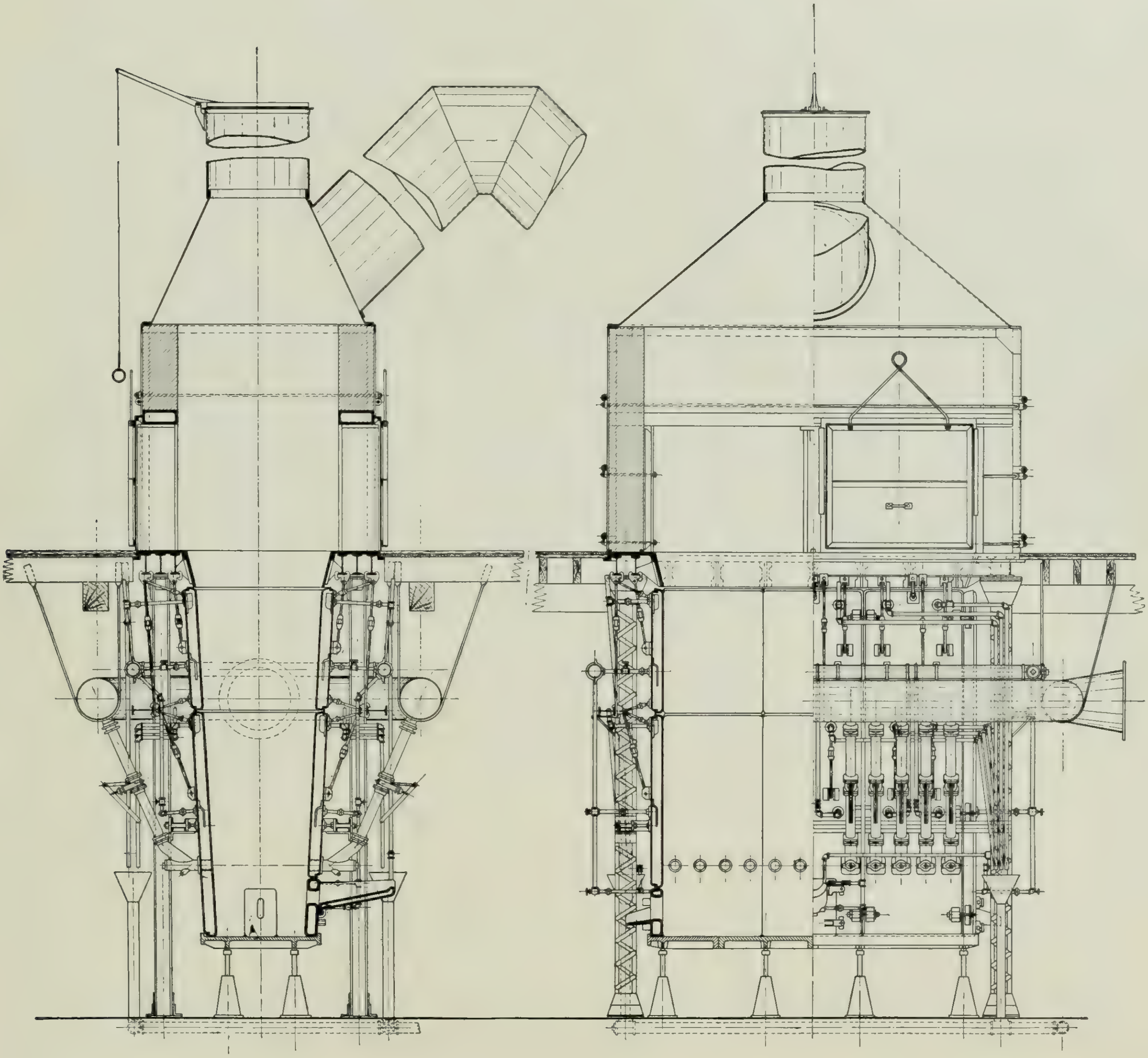
A main water supply pipe for conducting cooling water to the jackets encircles the furnace, near the top of the jackets, and is provided with all necessary branches and connections to the jackets. Suitable means are also provided for taking care of discharge water from the jackets.

Plate No. 10344



42 by 144 inch Rectangular Water Jacketed Blast Furnace, for Smelting Copper Ores
(See Sections in Plate No. 10486)

Plate No. 10486



Sectional End Elevation

Side Elevation

42 by 144 inch Rectangular Water Jacketed Blast Furnace, for Smelting Copper Ores

The mantle frame is made of heavy steel "I" beams and channels and rests upon four steel columns at the corners of the furnace. A heavy cast iron plate rests upon the mantle frame, forming a base for the brick work of the shaft. The cast iron base plate inclines downward on the inside of the furnace towards the top of the jackets, thus eliminating brick-work between the jackets and the charging floor which permits of removing the jackets easily. The inclined part of the base plate is removable.

The furnace shaft is made of good common brick and lined on the inside with 9 inches or more of fire brick.

At the charging floor level, openings are provided in each side of the shaft for charging the furnace. The bottom and sides of these openings are protected by heavy cast iron plates and the top of the opening is formed, either by a steel "I" beam Lintel Frame or a cast iron frame which carries the brick-work of the shaft above the charging openings. These openings are provided with steel charging doors which are balanced and made so as to open and close vertically.

The top of the furnace shaft is covered by a pyramidal shaped steel hood terminating in a connection for a round steel stack and arranged for downtake. The hood, stack and downtake are all made of steel and provided with dampers, etc.

We do not furnish the brick-work with our furnaces, but we include the steel frame for binding the brick which consists of steel angles, binding rods, etc.

We furnish the metal parts of furnace complete according to specifications; also the necessary drawings for properly erecting same.

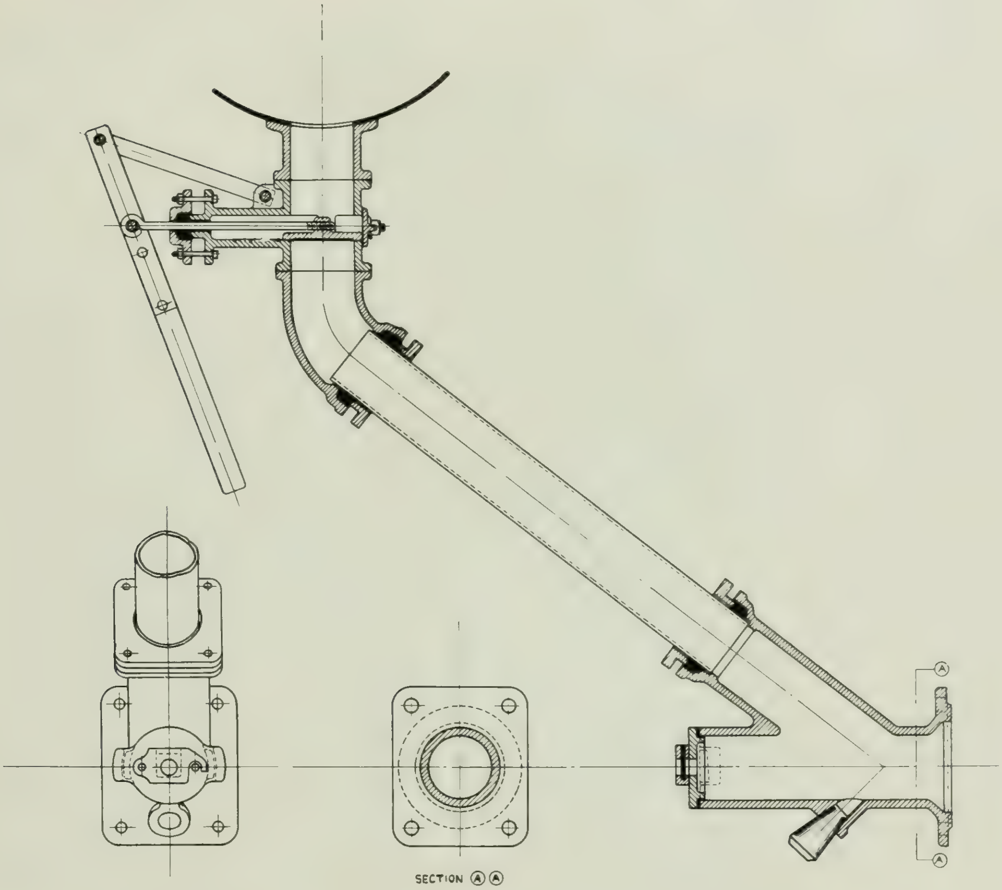
We make rectangular copper furnaces of any size desired. Some of the sizes of rectangular furnaces we have built, are as follows:—36″ x 72″, 36″ x 84″, 36″ x 96″, 36″ x 120″, 40″ x 162″, 42″ x 120″, 42″ x 144″, 42″ x 160″, 44″ x 160″, 48″ x 192″, 50″ x 240″. All inside dimensions at the tuyere lines.

COPPER FURNACE CAPACITY AND FUEL

The capacity of a copper furnace, like that of all other furnaces, varies according to the character of the ores, the fuel, and other conditions. Modern blast furnaces attain, on an average, a capacity of from five to six tons of charge per twenty-four hours per square foot of area at the tuyere level. Many of our furnaces have greatly exceeded this capacity, and this rating is only given for approximate calculations.

Coke is, of course, the most desirable fuel for copper furnaces, although charcoal is frequently used for small furnaces. The quantity of fuel required varies according to conditions, being from 7 per cent. to 8 per cent. of the weight of the charge in large furnaces handling heavy sulphides up to 16 per cent. to 18 per cent. in small furnaces treating oxide and carbonate ores.

Plate No. 10335



INDIVIDUAL TUYERES

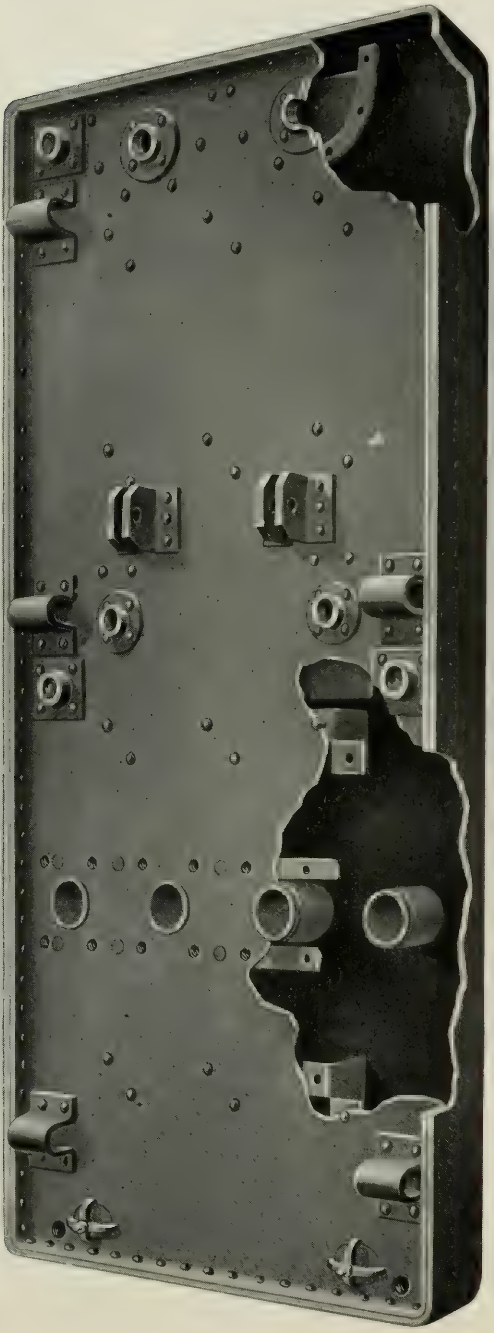
The above cut shows the design of our individual tuyeres, as furnished with our large smelting furnaces.

They are made of cast iron securely bolted to the water jacket, making an air tight connection to the bustle pipe.

The tuyeres are provided with a large opening with suitable peep sight made of mica; also wood safety plug and removable cap to allow of barring the furnace.

With this type of construction the escape of air is practically impossible and the quantity of air which enters the tuyere can be regulated.

Plate No. 10532



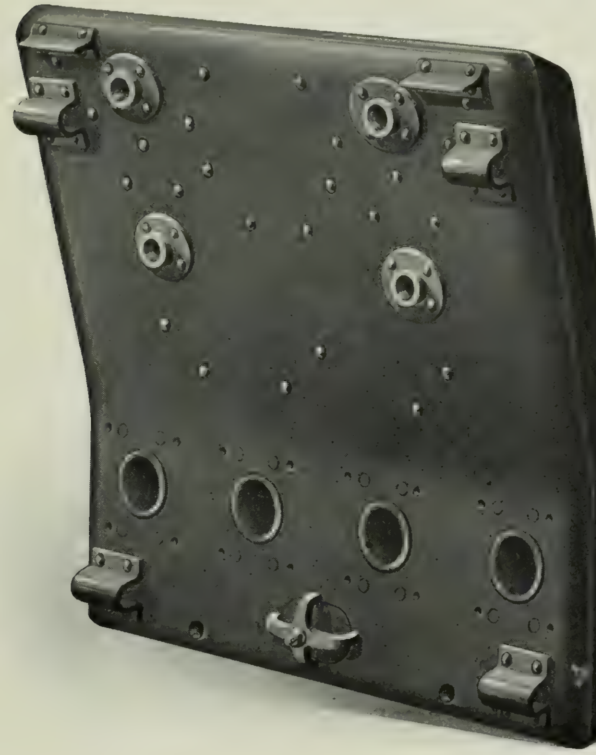
Riveted Steel Water Jacket for a Rectangular Copper Furnace

WATER JACKETS

All water jackets for modern blast furnaces are made of steel plate, due to the fact that this material is the most durable and free from blow holes, cracks, etc.

Allis-Chalmers Manufacturing Company employs in the construction of its jackets the most modern methods that are known, doing the flanging in a hydraulic press which insures practically a uniform thickness throughout; the corners are made true and square, and in the riveting and welding departments we employ only skilled workmen. Each of our jackets is submitted to a careful test before shipment, thus avoiding any difficulty which might possibly be encountered in its operation.

Plate No. 10531



Welded Steel Water Jacket (Patented)

We manufacture both riveted and welded jackets and are prepared to manufacture them in any size and shape. See plates 10531 and 10532.

All our jackets are rigidly braced between the front and back sheets with our special stays which are riveted to the back sheet only. No rivet heads appear anywhere on the front sheet.

Each jacket is provided with openings for the water feed and discharge pipes; the feed opening consisting of a flange riveted to the outside of the jacket and provided on the inside with a baffle plate located in such a manner as to divert the cold water from the fire sheet and distribute same properly throughout the jacket. The discharge consists of a pressed steel pocket riveted to the interior of the back sheet which is provided with a flange on the outside.

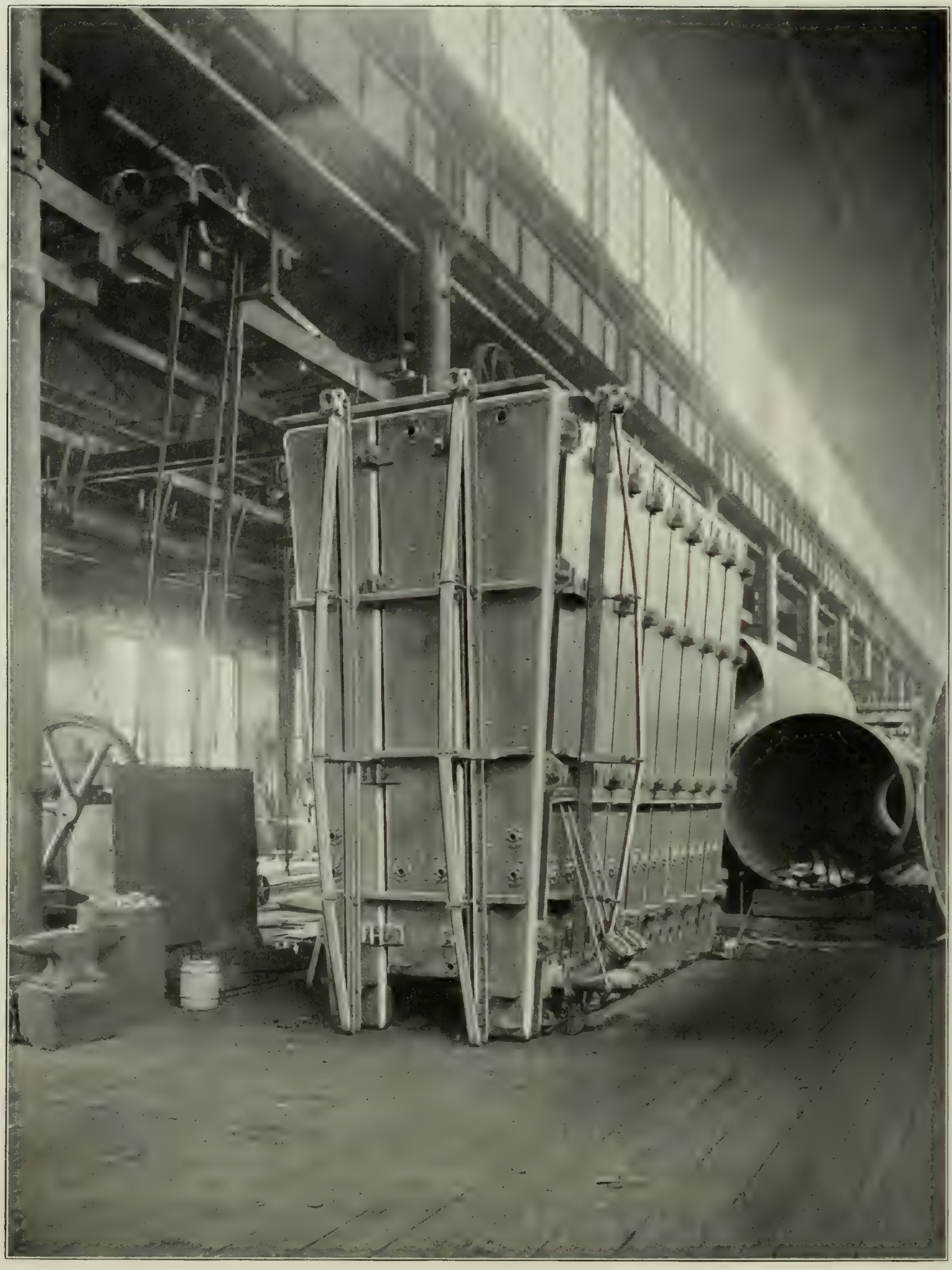
All our jackets are made higher at the back than at the front in order that the air and steam can not accumulate in the bend of the inner or fire sheet.

The tuyere openings are formed by steel tubes secured to the jacket plates in such a manner as to make an absolutely tight joint.

View of United Verde Copper Co

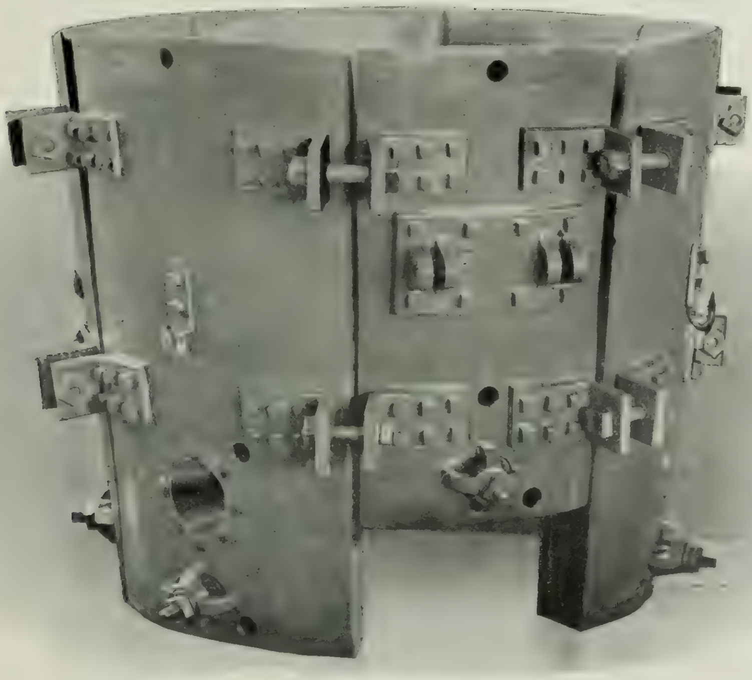
Smelter at Clarkdale, Arizona

Plate No. 10339



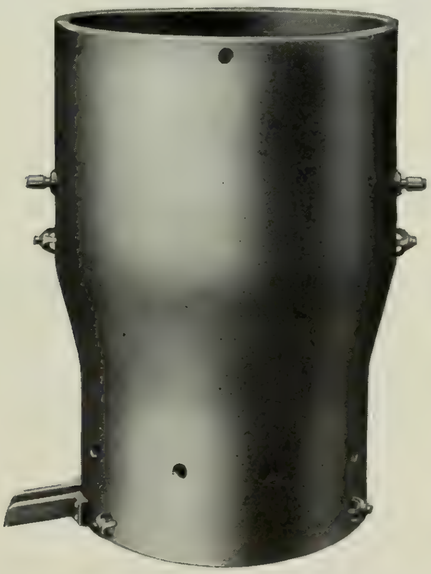
View taken in our Erecting Shop, showing a set of Welded Water Jackets for a 48 by 192 inch Copper Furnace. These Jackets are 14 feet high.

Plate No. 794



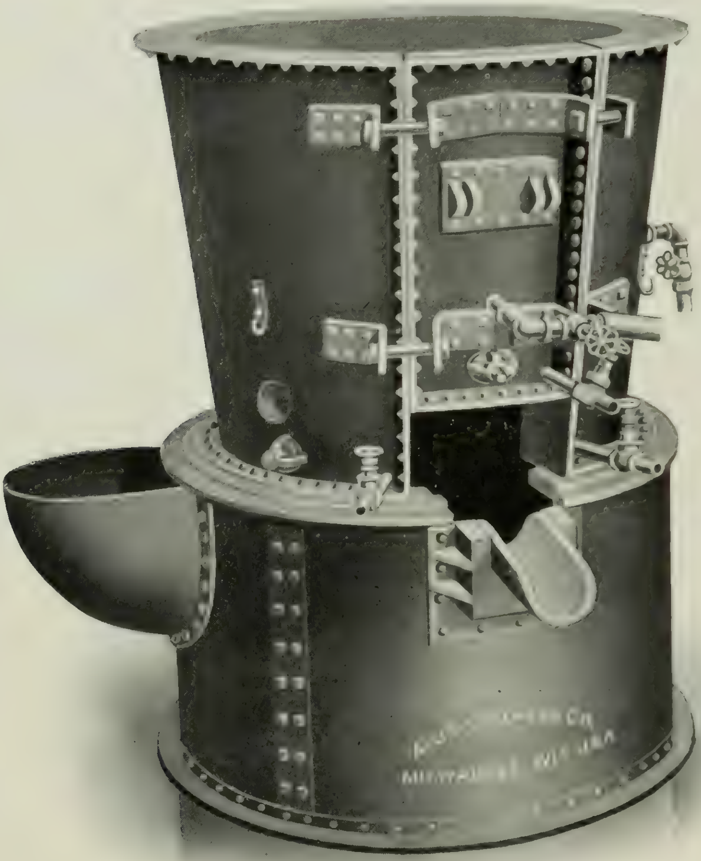
Welded Steel Water Jackets for a Sectional Round Lead Furnace

Plate No. 10528



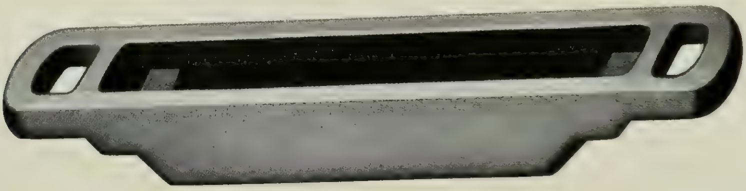
Seamless Plate Steel Water Jacket for a 48 inch Round Copper Furnace

Plate No. 1969



Curb and Jackets of Standard Round Water Jacketed Blast Furnace for Lead Ores

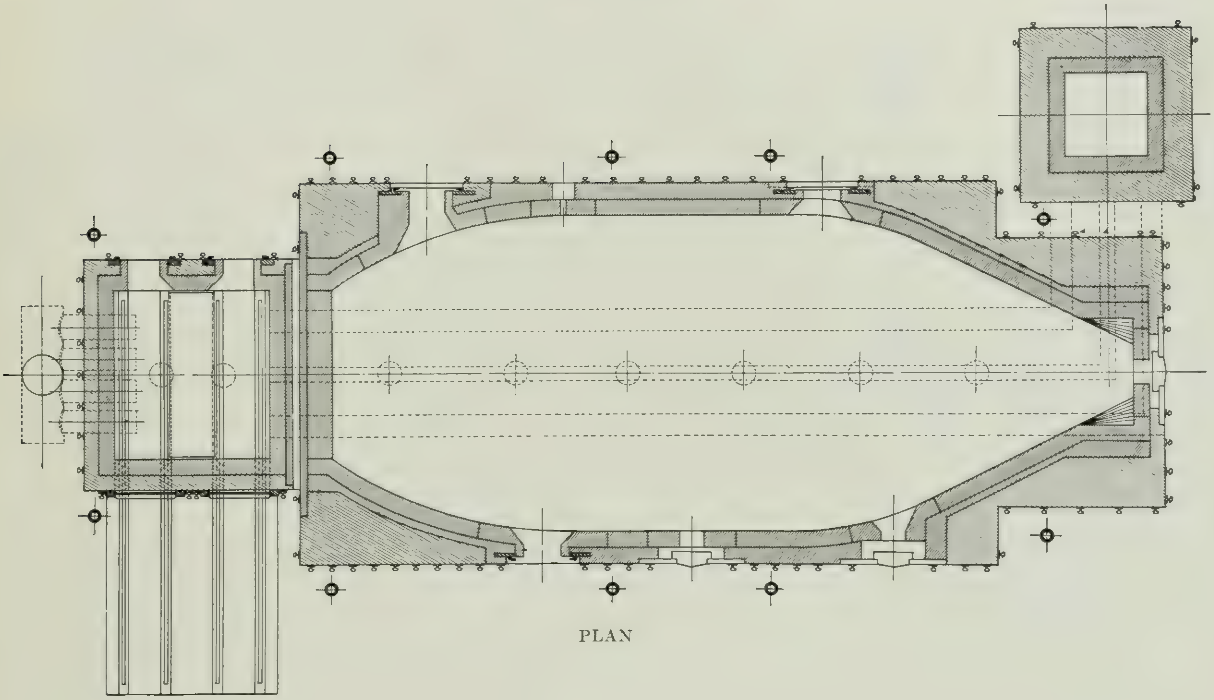
Plate No. 10506



LEAD MOULDS

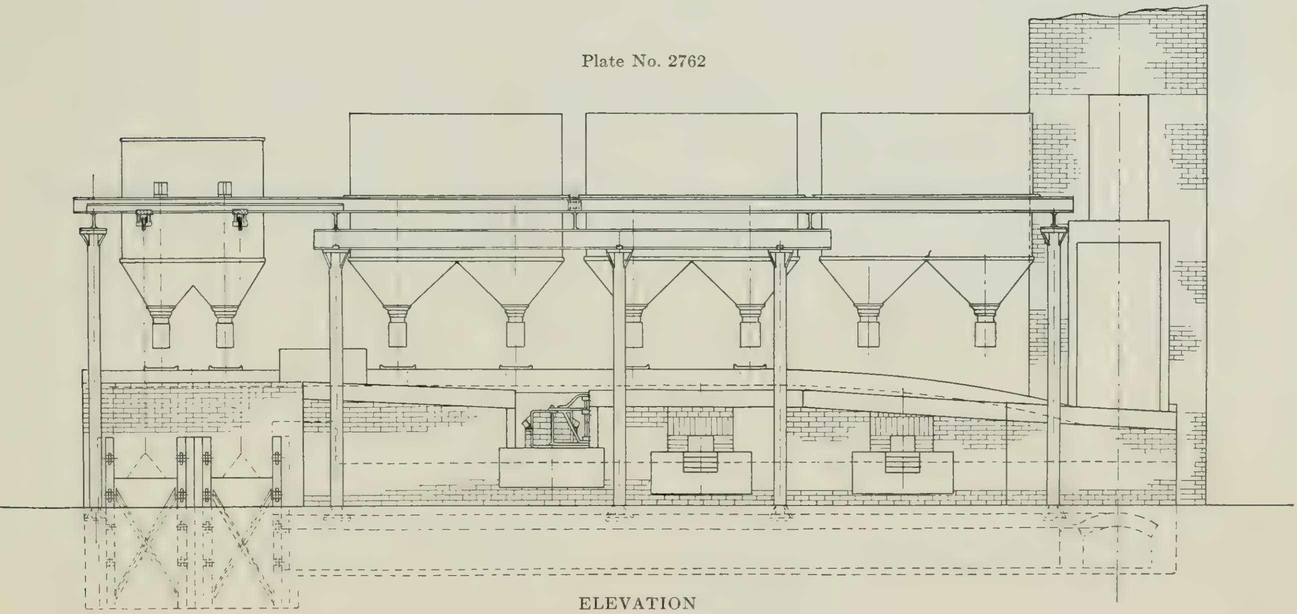
These are made of cast iron, steel or semi-steel, weigh about 45 pounds, have a capacity of 100 pounds of lead bullion and are cast with raised letters in the bottom with the name of the purchaser or the company.

Plate No. 2768



PLAN

Plate No. 2762



ELEVATION

Large Reverberatory Smelting Furnace

REVERBERATORY SMELTING FURNACES

Reverberatory furnaces are used for smelting fine ores, calcines, etc., which are unsuitable for treatment in a blast furnace. Plates 2768 and 2762 illustrate a large reverberatory furnace built for a western smelting plant and show the general design of a furnace of this type. We furnish iron-work and drawings for reverberatory furnaces of any desired capacity.

Large modern furnaces are equipped with ore hoppers on top near each side,—running practically the full length of furnace—provided with pipes for discharging the ore along the inside of the side walls, thus protecting same and keeping them cool and thereby eliminating fettling.

The modern furnaces are also arranged for firing with pulverized coal.

The large modern furnaces, arranged for side charging and with burners for pulverized coal, have greater capacity per square foot of hearth and the fuel consumption is very much less per ton of charge, than the fire box type.

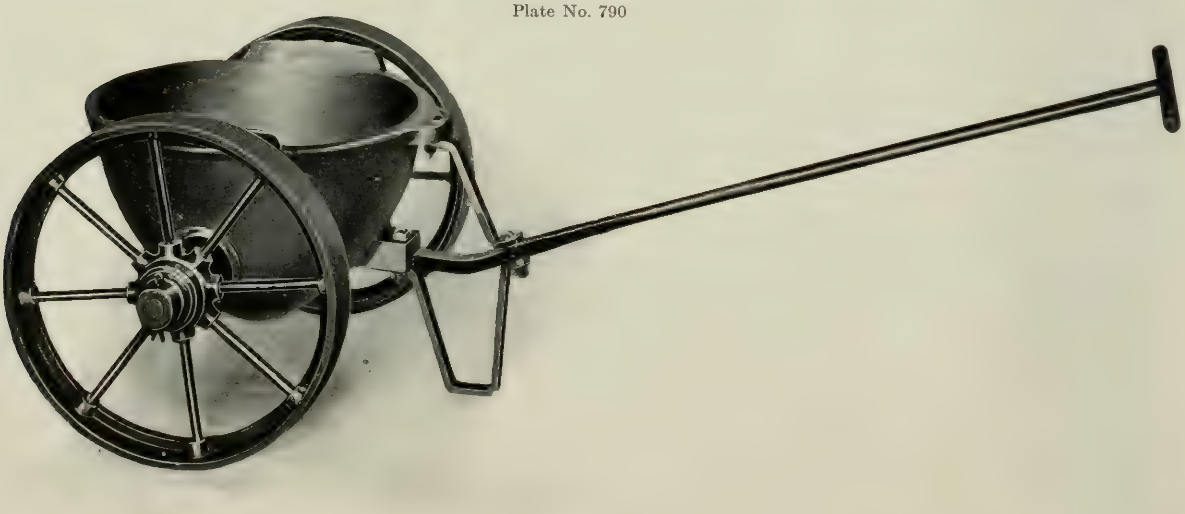
The waste heat from reverberatory furnaces is frequently used to generate steam; the boiler being set near one end of the furnace, and the gases passing through it on their way to the main flue or chimney.

FOREHEARTHS

For small round furnaces up to 42 inches in diameter our 36-inch settling pot, shown by plate 172, on page 31, forms a very convenient and efficient forehearth. This pot is mounted on anti-friction roller bearing wheels and is of such a height that the bowl of an ordinary slag pot passes underneath the overflow spouts. The bowls of these settling pots are made of a special mixture and are exceedingly durable.

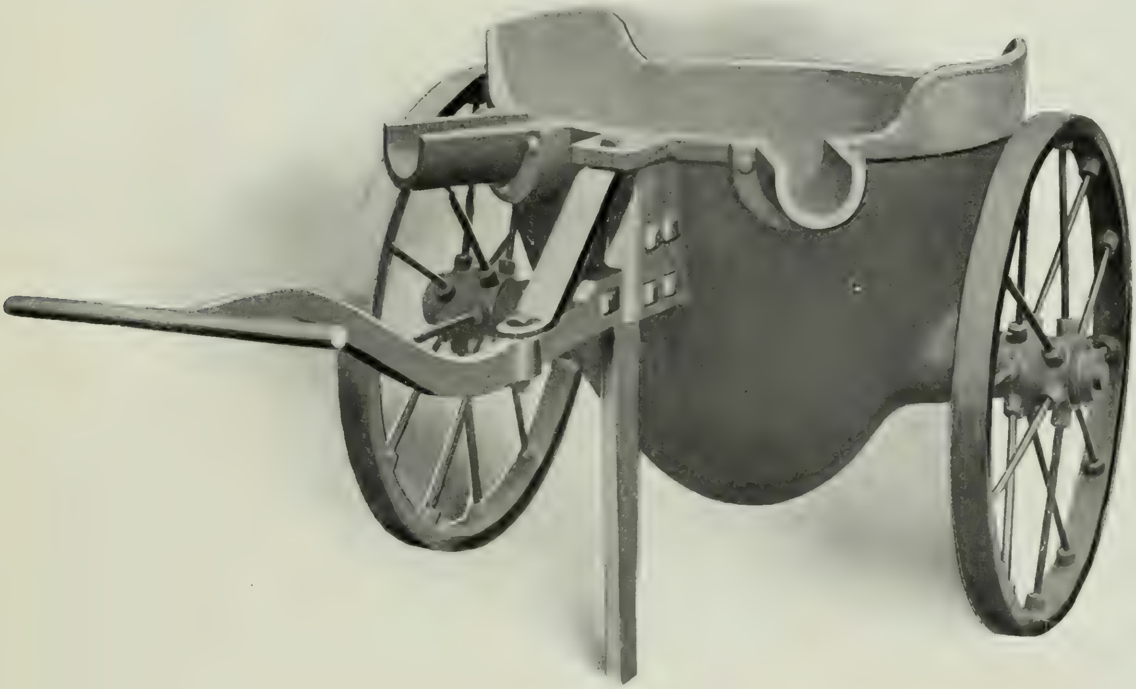
For furnaces of a larger size a rectangular cast iron forehearth, such as is illustrated by plate 10529 on page 31, is used. These forehearths are of a very strong and simple construction throughout. They are mounted on wheels so as to be easily removed from

Plate No. 790



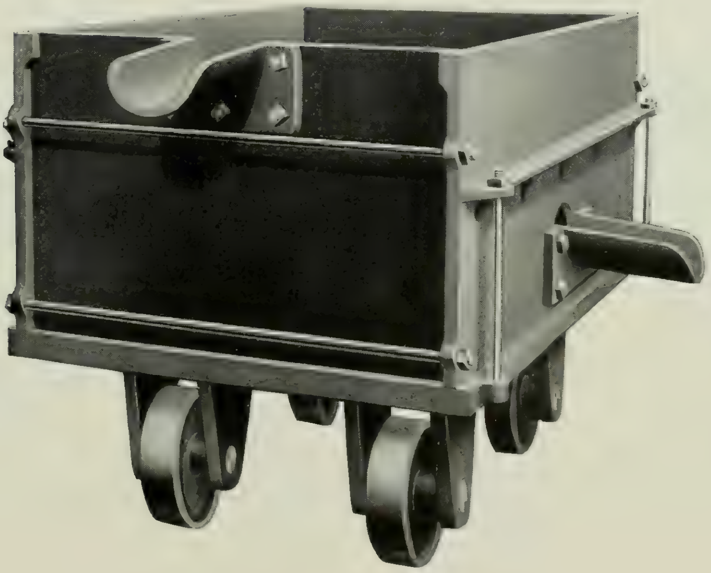
No. 8 Slag Pot

Plate No. 172



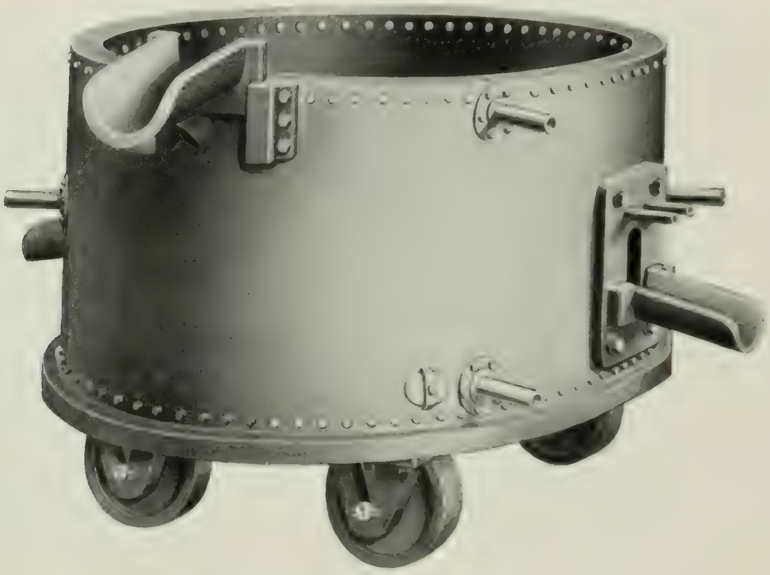
Large Settling Pot

Plate No. 10529



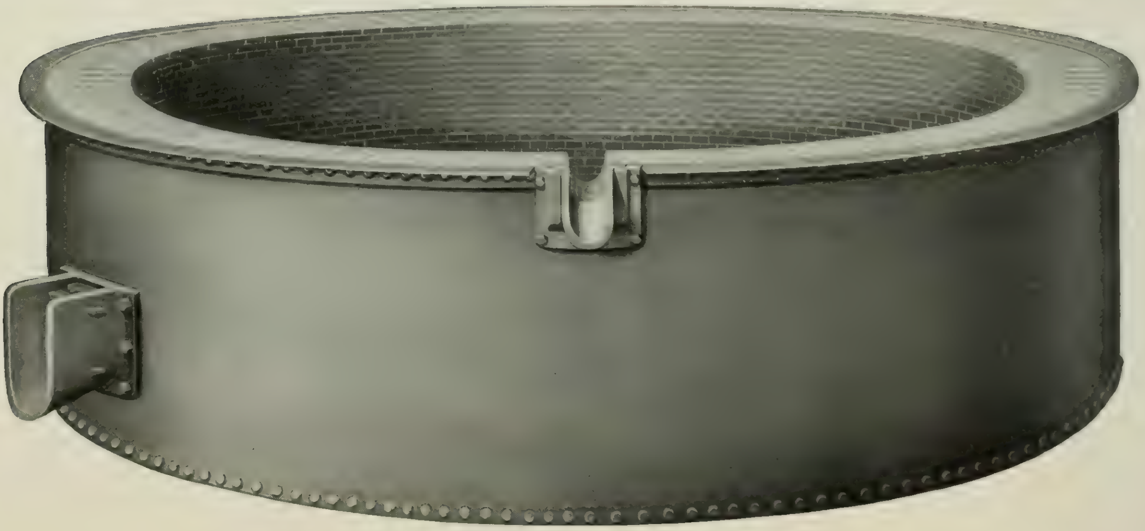
Rectangular Cast Iron Forehearth

Plate No. 10530



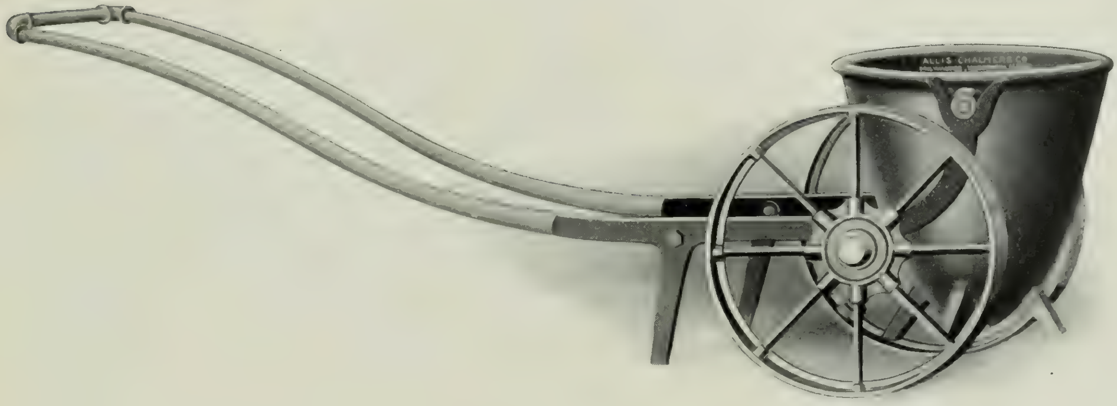
Elliptical Water Jacketed Forehearth

Plate No. 1895



Round Matte Settler

Plate No. 2754



No. 7 Slag Pot

the furnace for relining, or other purposes. We make them in several sizes to suit the various furnaces.

Plate 10530, on page 32 illustrates an elliptical-shaped water-jacketed forehearth. This type of forehearth is preferred by many metallurgists for use with copper matting furnaces. It consists of a steel plate water jacket mounted upon a heavy cast iron base plate, which is carried by four wheels. These forehearths are, of course, made in sizes to suit the furnaces with which they are used.

In large copper matting plants a forehearth is usually known as a "settler." A large matte settler is illustrated by plate 1895, on page 32. These settlers are made of heavy steel plate and are from 10 to 18 feet in diameter, according to the size of the furnace with which they are used. They are lined with either fire-brick or magnesia brick and are stationary. These large settlers afford ample space for the matte to separate from the slag, and, in addition, give a large storage capacity for matte ready for the converters.

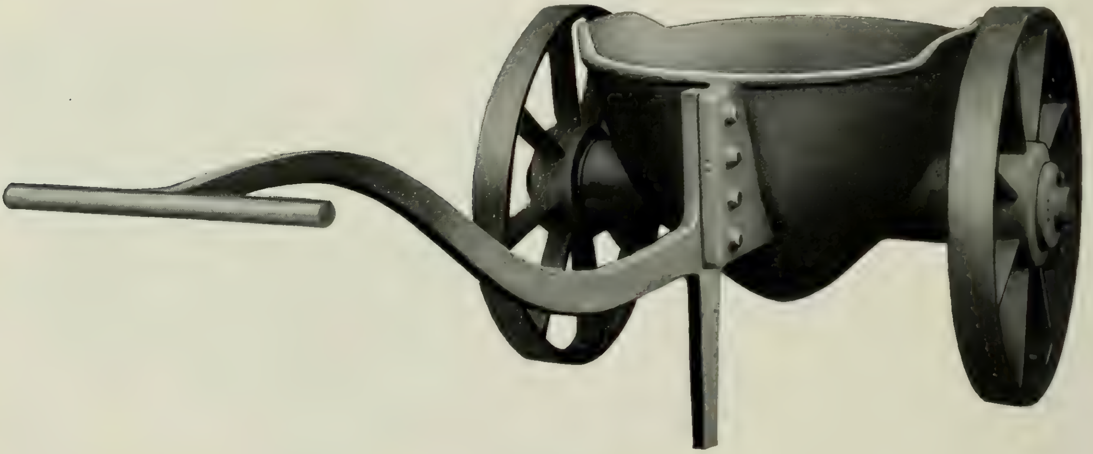
SLAG, MATTE, AND BULLION POTS

Our standard No. 8 slag pot is illustrated by plate 790. This pot has a capacity of two cubic feet, is mounted on wheels of 24 inches diameter, having anti-friction or roller bearings, and is of very strong construction throughout, being designed for rough usage. The wheels, axles, handle, foot, etc., are readily removable from the bowl, so that, in case of the bowl cracking or being broken, these parts can be easily placed on a new bowl and the pot restored to serviceable condition.

This is our standard hand pot and it is used extensively. In addition to being used as a slag pot it is frequently used for handling matte and like purposes.

Allis-Chalmers No. 7 pot, shown by plate 2754, is for use in small plants where weight in transportation is an important item. The bowl of this pot is separate from the carriage and is provided with three legs to rest upon the ground so that one carriage may serve for a number of pots. The carriage is of wrought iron, the wheels are 24 inches in diameter and have anti-friction roller bearings.

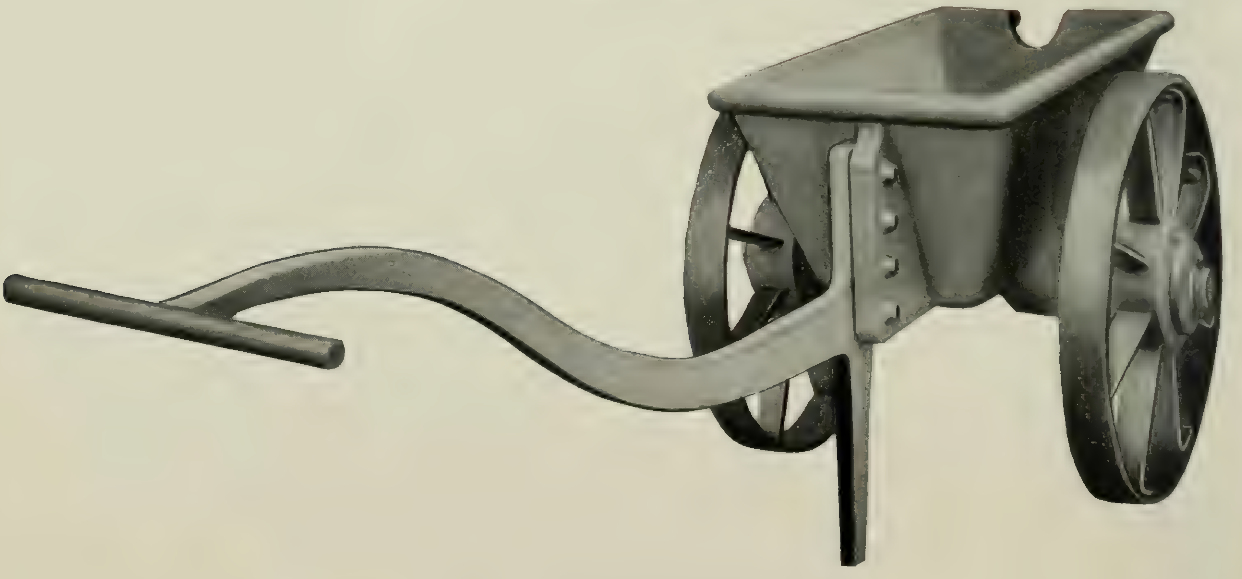
Plate No. 779G



No. 9 Slag Pot

Plate 778G illustrates our No. 4 copper bullion mold which is used for either matte or black copper. The bowl is of the special grade of cast iron we use for all slag and other pots and is mounted on anti-friction wheels and has a handle like that of slag pot No. 9.

Plate No. 778G



Anti-Friction Copper Buillion Mold

SLAG CARS

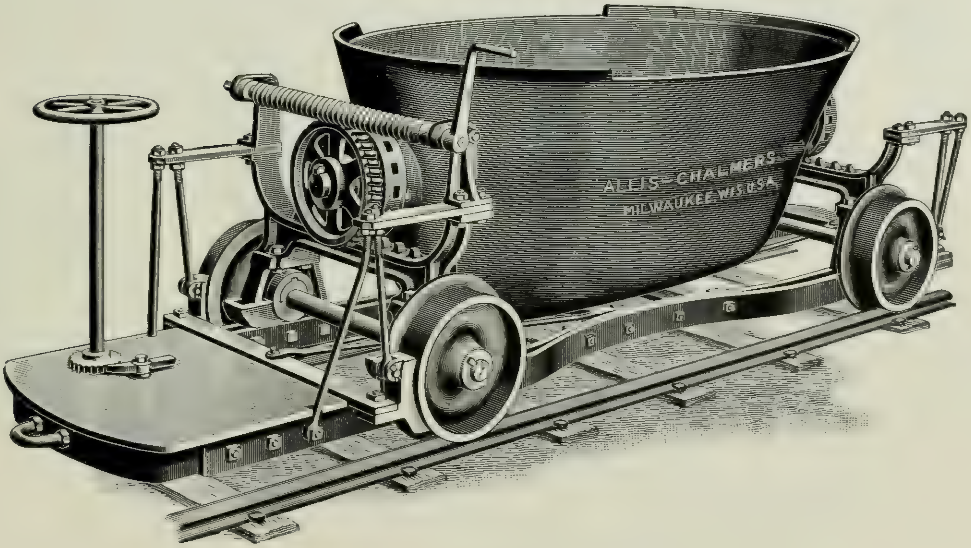
Various means are employed at smelting plants for disposing of slag. In small plants, hand pots are used. In larger plants slag cars having capacities varying from 10 to 250 cubic feet each, depending upon the size of the smelter, are used. These cars are drawn by steam or electric locomotives and, in some small plants, by horses and mules.

Plates 1435 and 1436 illustrate Allis-Chalmers standard 25 cubic foot slag car which is largely used about medium sized plants. The frame of this car is built up of steel and is extended at one end to carry a platform. The axles run in brass journals and the wheels are provided with a brake. The bowl of the car is round and readily removable from the trunnion ring. The trunnion ring is forged of steel and supported in trunnion wheels at each end. The car is tipped by a screw and worm wheel at one end, as shown in the cut. The car is of very heavy and simple construction throughout.

Plate 2757 shows an oval bowl slag car which is built in sizes of from 40 to 80 cubic feet. This car is of substantially the same construction as the round bowl car, excepting that the bowl is not provided with a trunnion ring.

Cars of 100 cubic feet capacity and larger are always of special design and are therefore not illustrated. The company is always ready to furnish estimates upon cars of any capacity required. Large cars are frequently tilted by means of a small electric motor or with an air cylinder, as the tilting can be more quickly done by these means than by hand.

Plate No. 2757



Oval Bowl Slag Car

Plate No. 1436

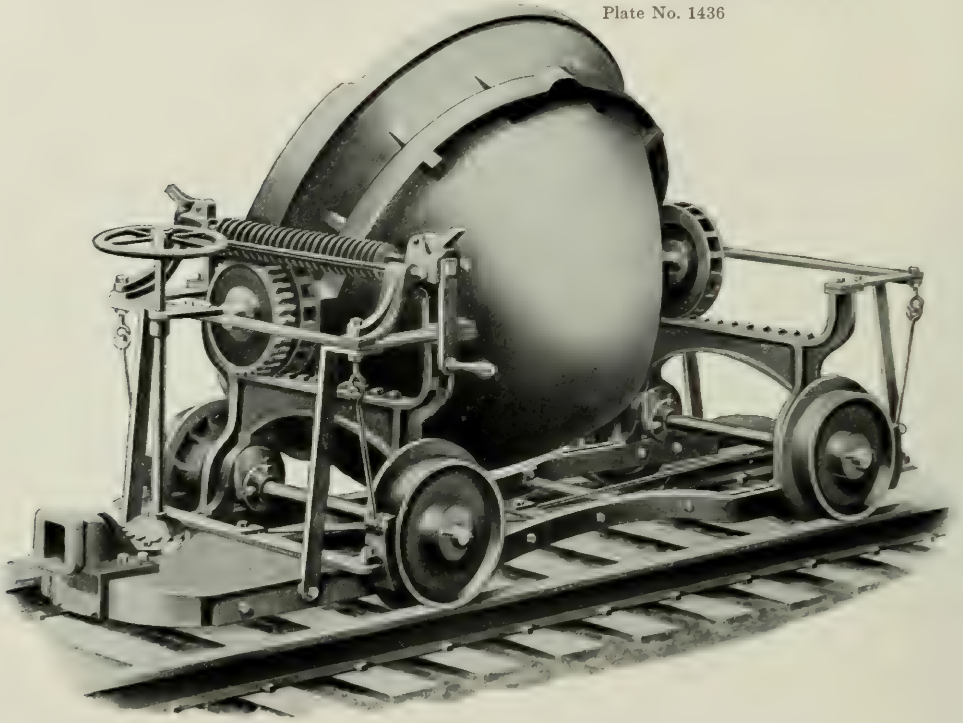
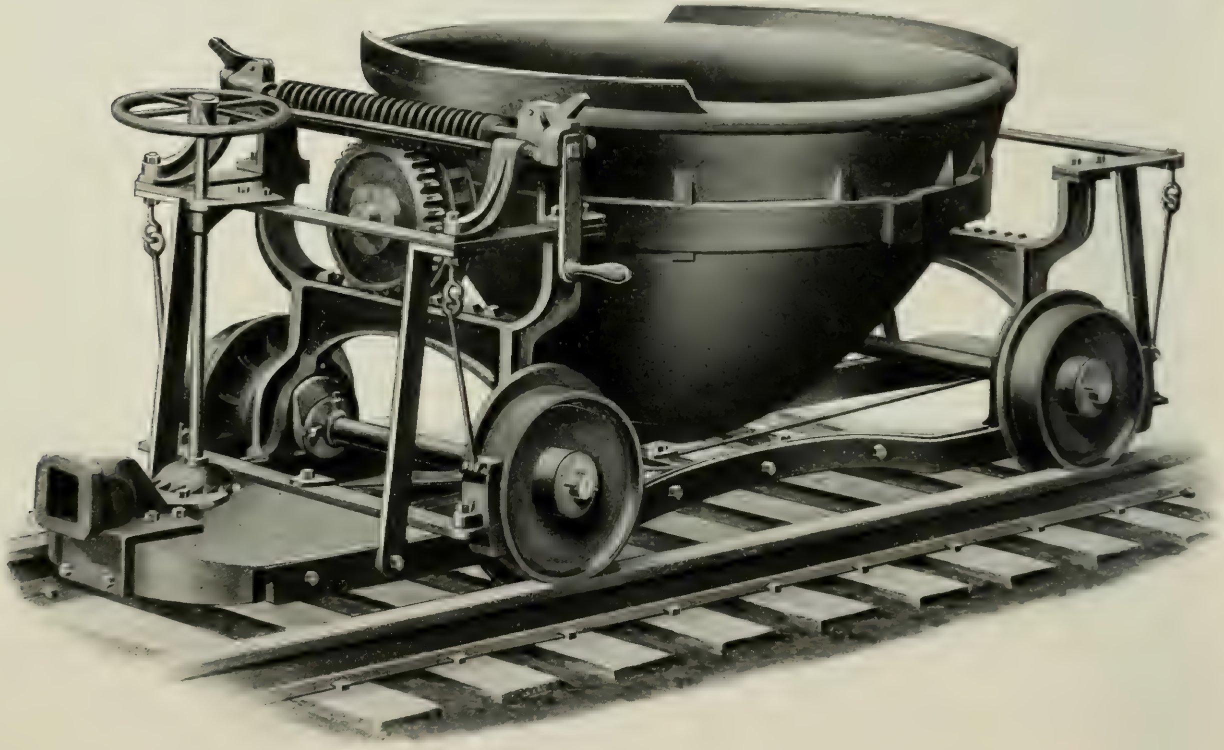


Plate No. 1435



Round Bowl Slag Car with Bowl Upright and Tilted

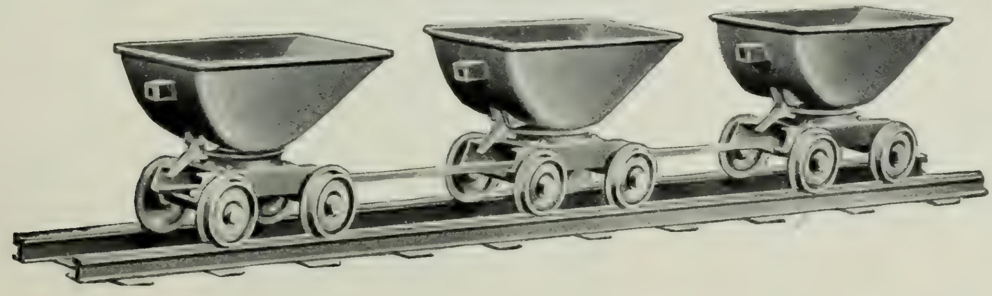
THE BENNETTS-JONES PATENTED SLAG CAR

A simple, substantial slag car, having a capacity midway between the regulation hand pot and the large slag pot now common about modern smelting plants, has long been desired. The Bennetts-Jones patented slag car, illustrated and described in our Bulletin 1414, meets the above requirements in every way.

This car consists of an approximately rectangular scoop-shaped cast-iron body with bowl mounted upon a turn-table which is carried by a structural steel frame mounted upon flanged wheels. The dumping of the body is effected by placing a bar in a hole cast in a lug on the back end of the body and releasing the lever shaped catch on the turn-table under the body. In dumping, however, the body can be swung to discharge the contents of the car in any direction desired. The bowl is restored to position by simply bearing down on the bar, when it is automatically locked in place by the above-mentioned catch.

The trunnions under the bowl of the car, upon which it turns in dumping, are so located that very little effort is required to dump the car or restore it to its original position.

Plate No. 3794



The first impression gained in looking at the car is that of the utter simplicity of it and the small possibility of trouble or repairs.

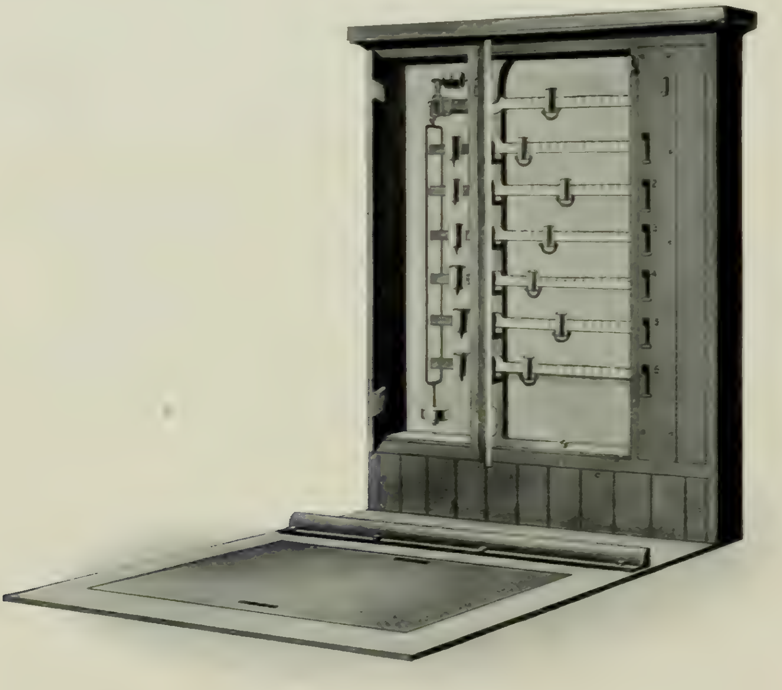
The second impression is the ease with which the cars can be handled. Both of these impressions have been thoroughly borne out by the use of these cars at the plant of the Tacoma Smelting Company. At this plant it has been found that one man with an electric locomotive can haul thirty of these cars per hour a distance of one thousand to fifteen hundred feet and dump and return the cars to the furnace, which is equivalent to approximately 575 tons of slag handled per day.

A very important advantage of this car is that it throws its contents a considerable distance beyond the side of the track where discharged. When the slag has solidified, the cake is thrown at least two feet beyond the ties and by using pieces of old rails as skids the cakes can be thrown a distance of eighteen to twenty feet from the track. With slag in a molten condition it will be delivered a distance of eighteen inches to two feet from the edge of the track.

CHARGING APPARATUS, SCALES, BARROWS, CARS

Smelting furnaces are charged in various ways, the tendency in late years being to eliminate hand labor where possible and substitute mechanical means thereby reducing costs. For mechanical charging, various types of cars are used. In some cases the cars have drop bottoms and either travel over the furnace or run inside on special tracks to discharge their load. In other plants, side-dumping cars of various types are used. Each type of car has its advocates and each operates successfully under certain conditions. Mechanical charging is employed almost entirely for large plants where a saving of a few cents on each ton of material handled means many dollars saved at the end of a year's run. The system of charging and the type of car to use depend largely upon the character of the ores to be treated and the size of the plant. Each installation must therefore be carefully designed to meet the particular requirements of the case and to be most efficient.

Plate No. 2749



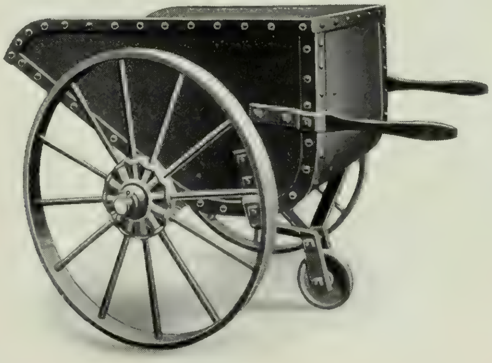
ORE CHARGING SCALES

Most small furnaces and many large furnaces are charged by hand. The charges are weighed on multiple beam scales, as shown by plate 2749. These scales are built with as many beams as may be required, each beam being independent of the others and having a self-locking poise, and the entire set is mounted in a case provided with a lock and key.

Each beam is set for the required quantity of one of the materials required to make up a furnace charge and the case door is locked. As each barrow of material is wheeled upon the scales, the proper beam is released by a small lever on the outside of the case and a pointer attached to the end of the beam indicates whether or not the barrow contains the required amount.

The style of charging barrow most used for ore and fluxes is shown by plate 10522. This barrow has a capacity of 10 cubic feet. It is made entirely of steel and mounted on anti-friction roller-bearing wheels. For coke, the barrow shown by plate 902 is used.

Plate No. 10522



Steel Charging Barrow

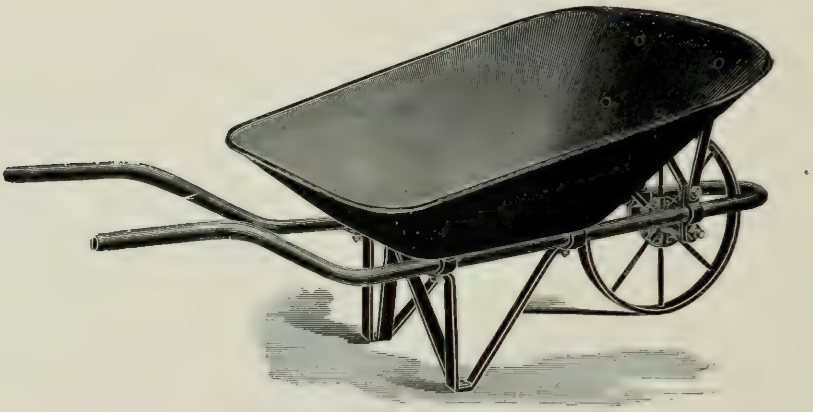
This barrow has a capacity of 7½ cubic feet and is made entirely of iron and steel. Tubular steel tray barrows, as shown by plate 903, of various sizes are also largely used about smelters, especially in the case of smaller plants.

Small cars of various types are used in and about smelters for many purposes. Our all-steel square bodied mine car, shown by plate 9773, on page 41, is extensively used for transporting materials from one part of a plant to another. Our steel scoop car, shown by

Plate No. 902

Two-Wheel Coke Barrow

Plate No. 903

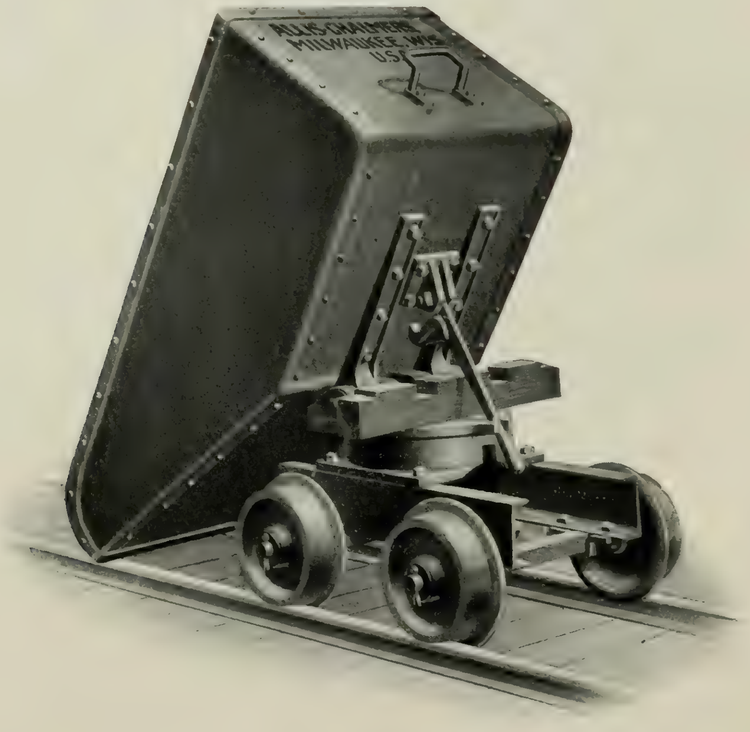


Tubular Steel Wheelbarrow

plate 2770, is also largely used, especially for fine materials. Steel hopper-bottom cars, as shown by plate 2764, are used principally for handling hot materials, such as calcines. Side-dump, rolling-dump, gable-bottom and various other types of cars are also used and are furnished of any capacity or construction required.

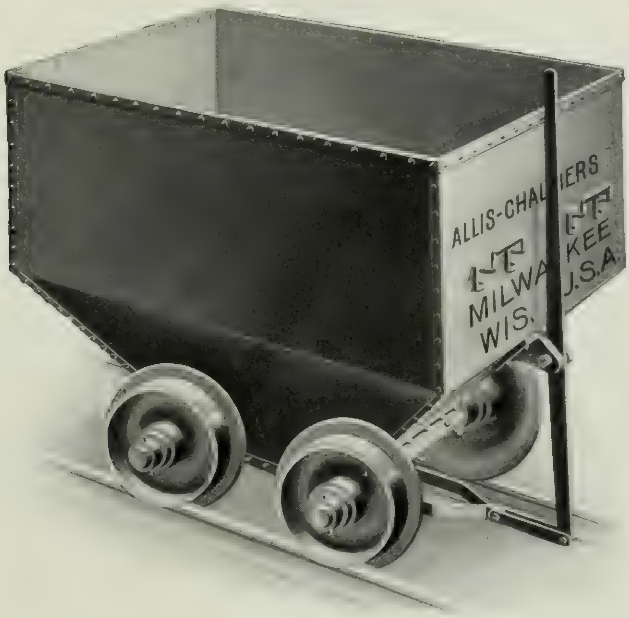
All tools, such as shovels, coke forks, sledges, furnace bars, etc., required by smelting plant, are furnished, but these articles are so well known that it is not deemed necessary to devote any space to their illustration or description.

Plate No. 2770



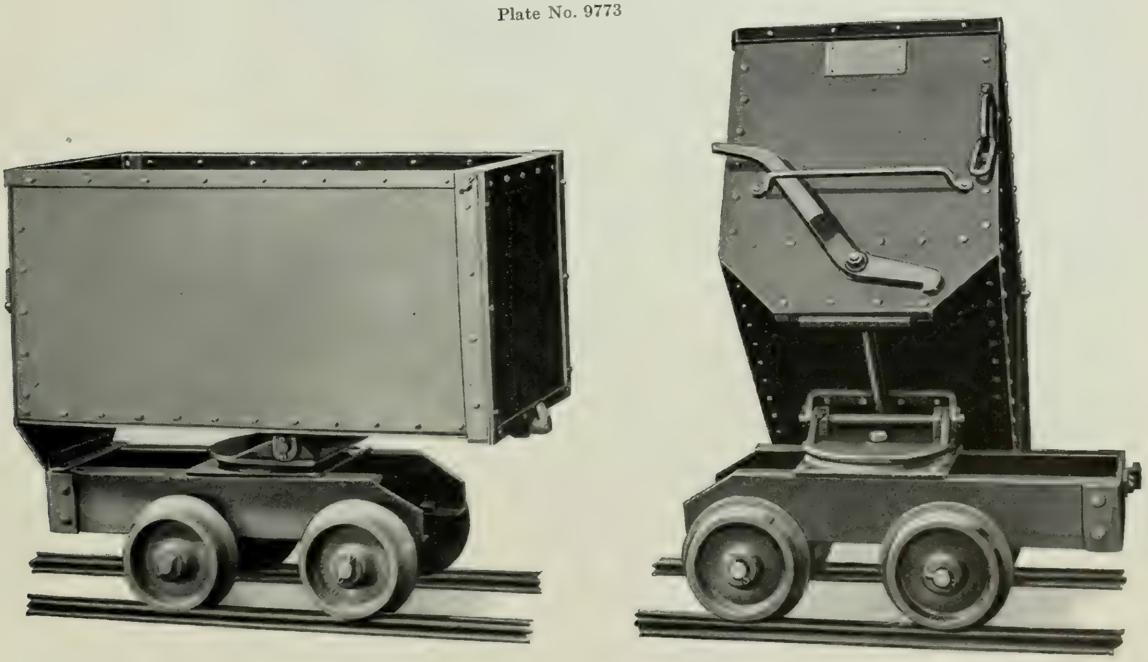
Scoop Car

Plate No. 2764



Hopper Bottom Car

Plate No. 9773

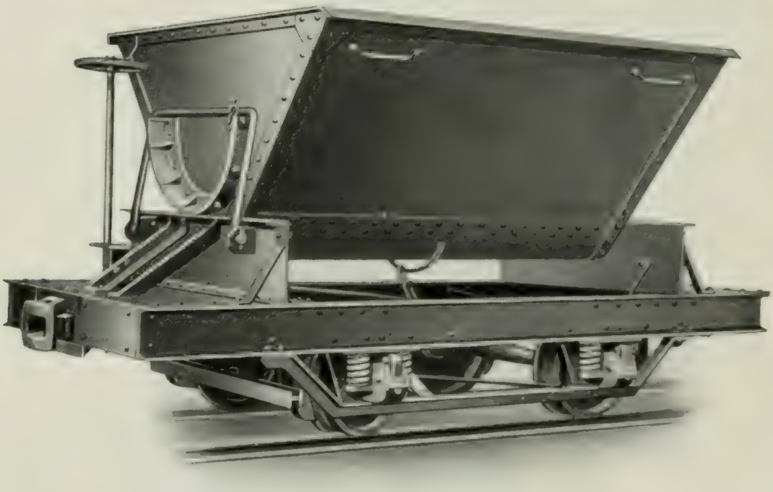


Side and End Dump Car

NOTE:—We are prepared to furnish ore cars of any desired design or capacity

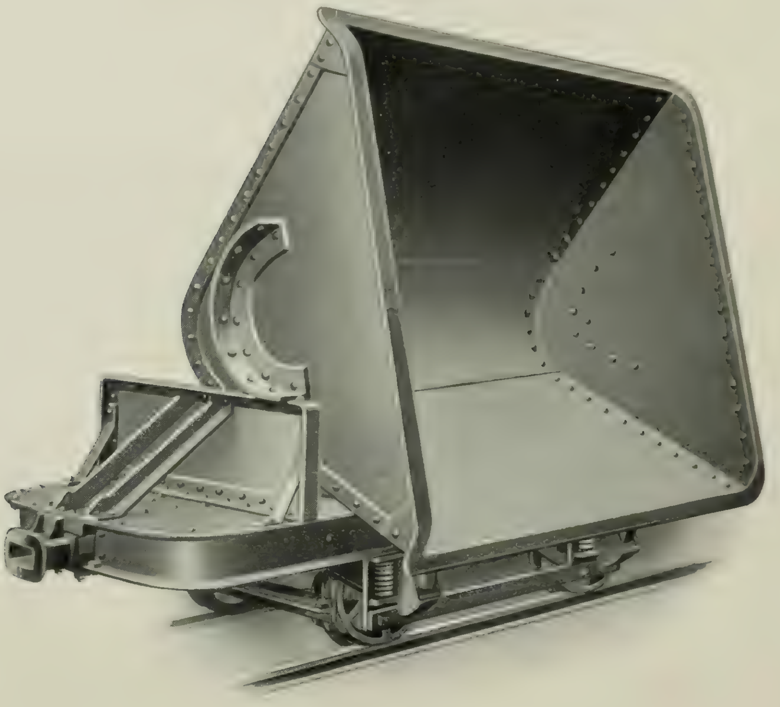
CHARGING CARS—TYPE "V"

Plate No. 10520



Showing Car with Body in Upright Position

Plate No. 10519



Showing Car with Body Turned, as When Dumping

The above cuts show the style of charging cars most frequently used in the large smelters. These cars are equipped with brake and also with coupling and pin. The cars are manufactured from the very best material.

BLOWERS

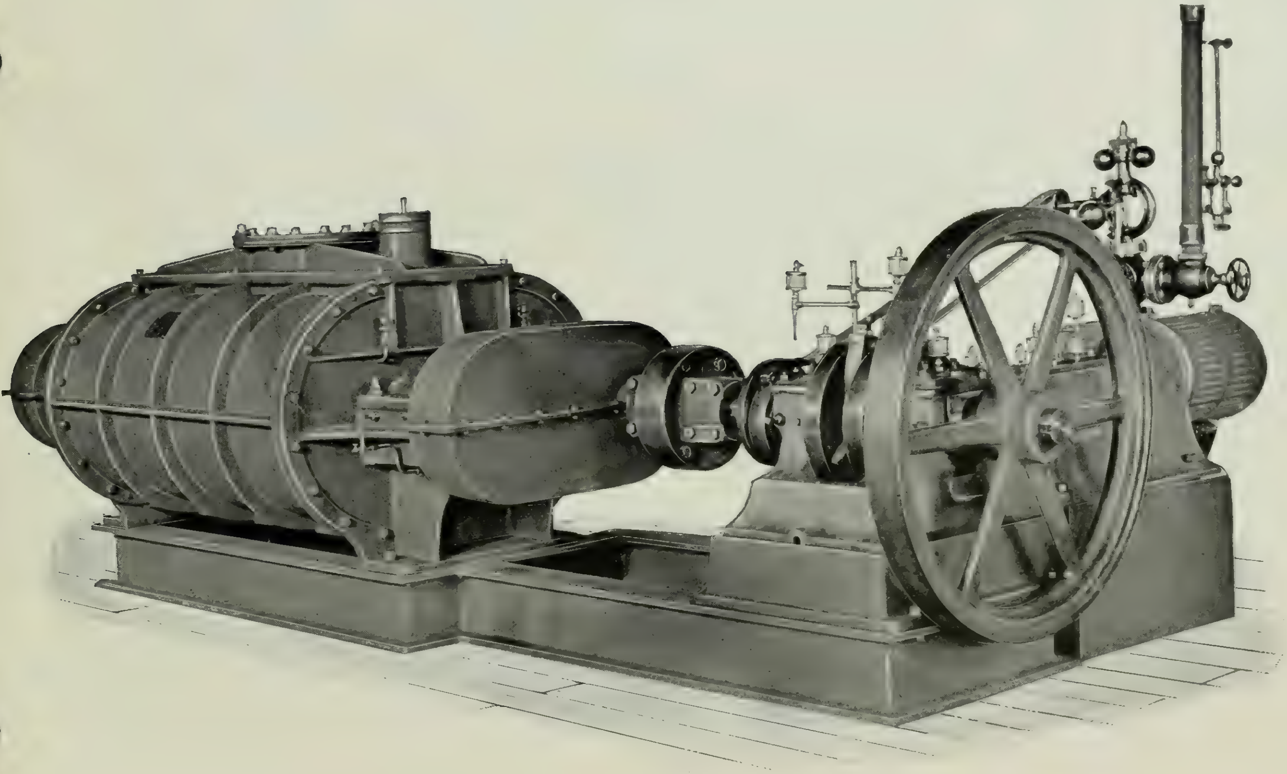
For furnishing the blast required by smelting furnaces, positive pressure blowers of the two-impeller type are generally employed.

The Connersville Blower is without doubt the best blower on the market for smelting service. Allis-Chalmers Manufacturing Company furnishes these exclusively with its smelting plants. Attention is called below to a few of the many improved and valuable features embodied in the construction of this blower.

In the Connersville Blower the impellers are each cast in a single piece strongly ribbed on the inside and carefully finished on the outside.

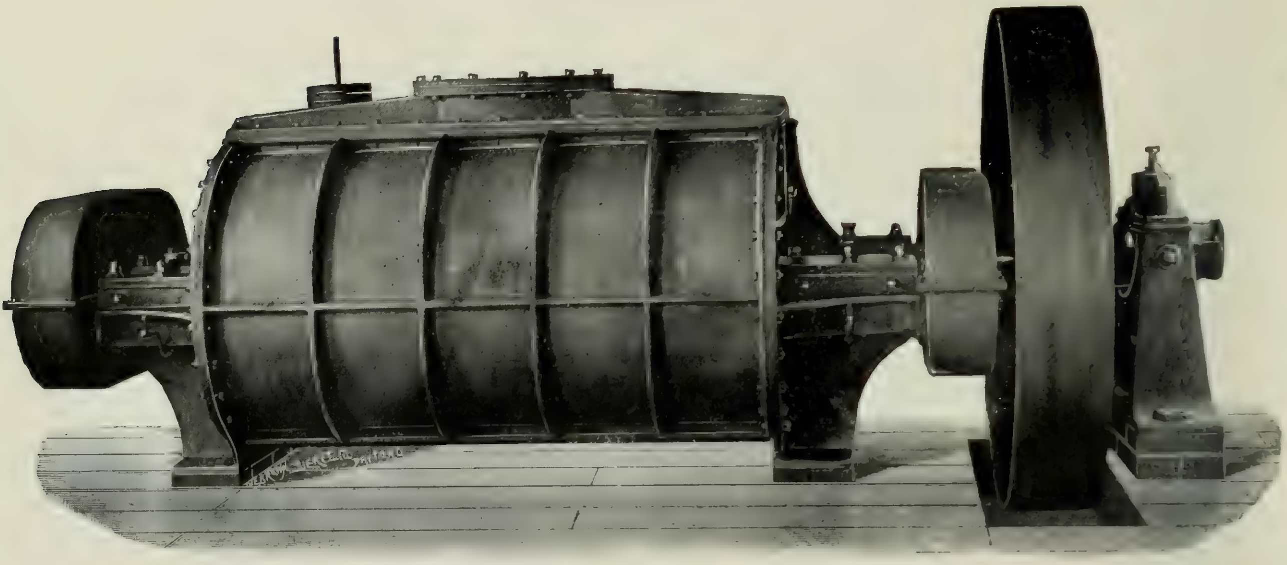
The contact surfaces are formed on mathematically correct lines and are finished accurately with two cuts. This construction makes it certain that the impellers will revolve together with uniform clearance and without metallic contact either with each other or with the surrounding casing. This avoids internal friction.

Plate No. 1975



Horizontal Blower Direct-Connected to Slide Valve Engine

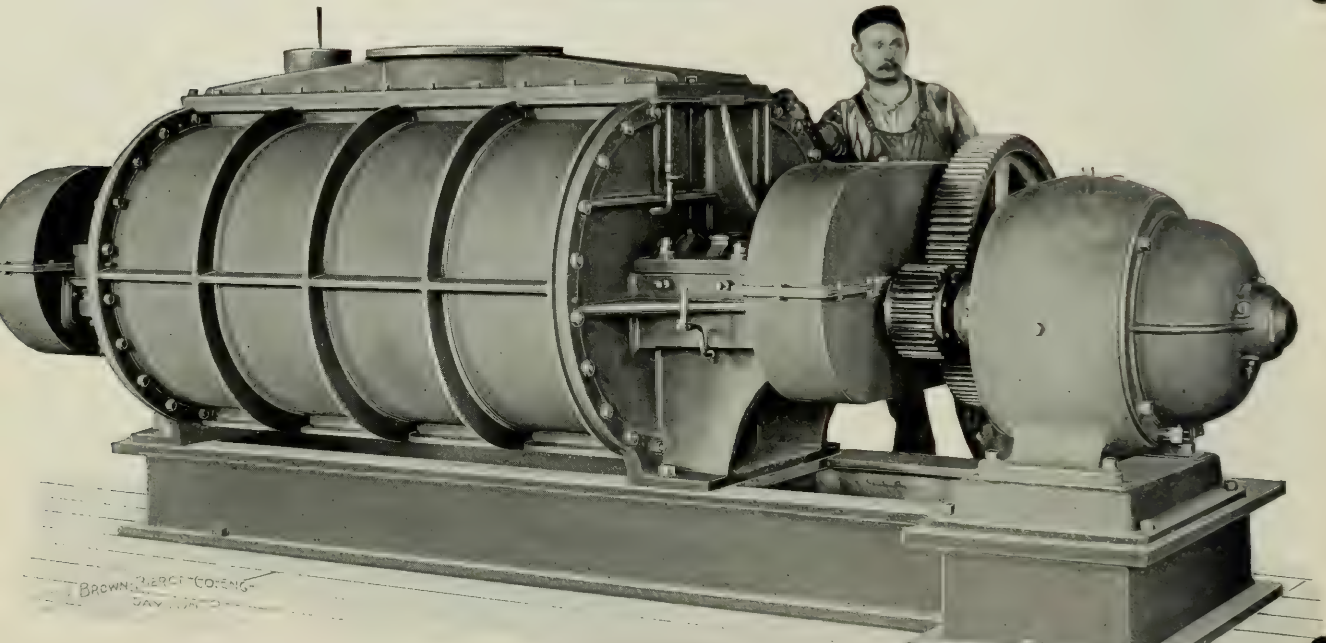
Plate No. 2758



Horizontal Blower

Top Discharge with Relief Valve in Pipe Plate. Driven by One Large Pulley. Driving Shaft Supported by an Outboard Bearing. Recommended for heavy duty when it is not convenient to use two pulleys

Plate No. 2769



Horizontal Blower, Geared to Electric Motor on Same Bed Plate

There are no waste spaces between the impellers to cause air pockets and no sharp corners or edges to produce sound vibrations. These impellers being symmetrical with respect to the shaft centers are balanced at all speeds.

The casings or cylinders of the blower are heavy and well ribbed on the exterior. They are bored accurately by special machinery.

The pipe plates of the casing are also strongly ribbed so as to be able to carry the weight of substantial blast pipe without springing the blower casing.

The feet at the base of the machine are broad and heavy, giving a large bearing on the foundation and eliminating any danger of their being broken during transportation.

The impeller shafts are of large size and made of a special steel. They extend full size through the blower.

The bearings are of a patent, adjustable quarter-box type and are ring-oiling.

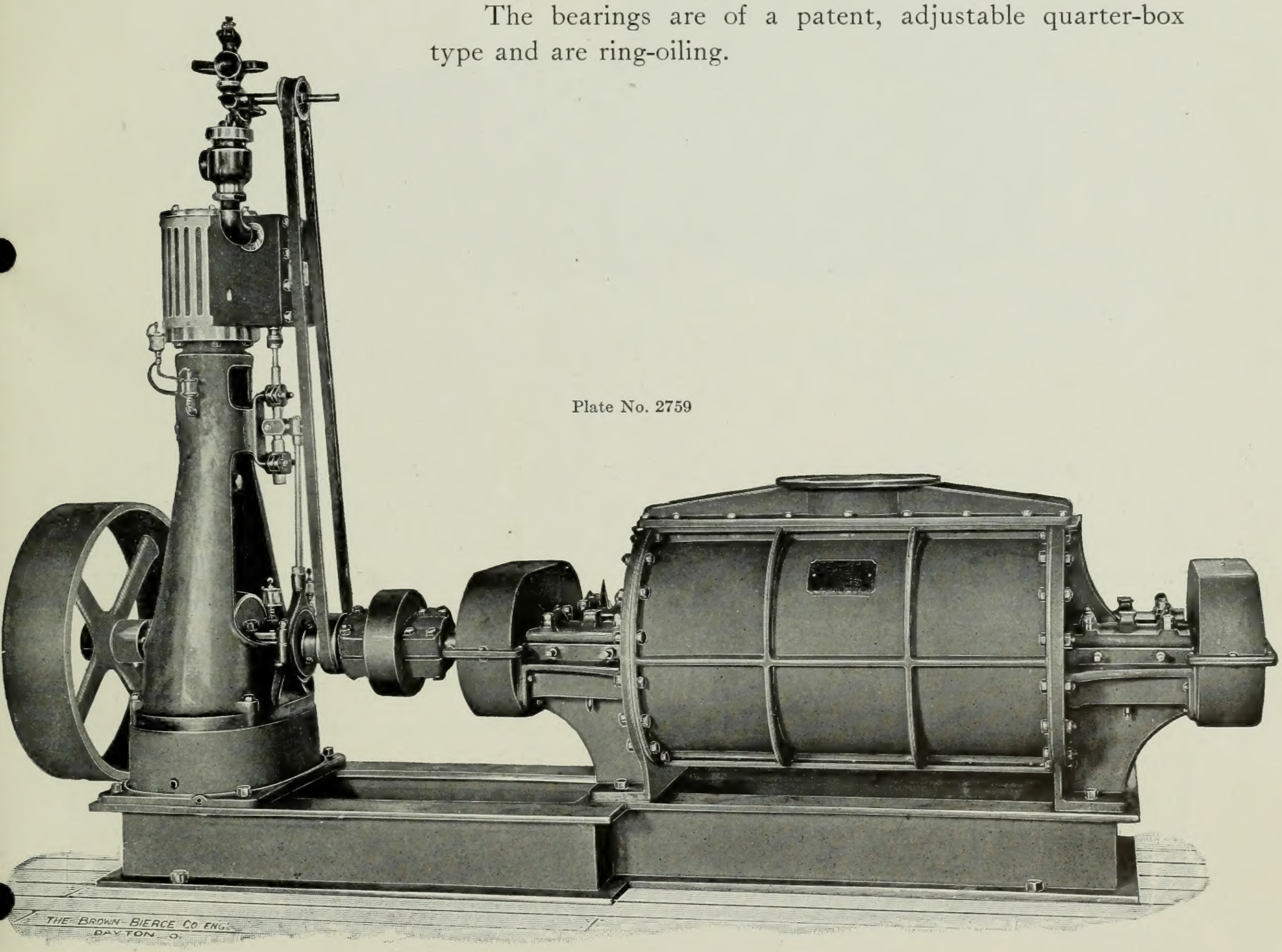


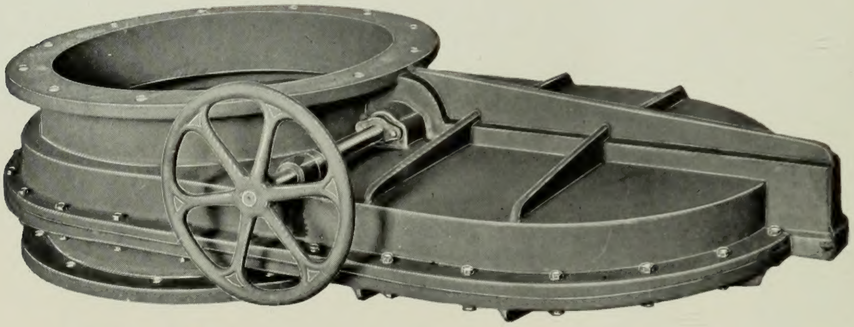
Plate No. 2759

Horizontal Blower with Vertical Engine on Same Bed Plate

The gears have wide faces and are accurately cut from the solid metal by special machinery. There is a pair of gears at each end of the blower running in oil-tight casings.

The Connersville Blowers are designed especially for smelting service and are built in various capacities up to 400 cubic feet displacement per revolution. On the preceding pages we illustrate Connersville Blowers arranged to be driven by belt, by gearing to an electric motor, and directly connected to a vertical or horizontal engine. The larger sizes of Connersville Blowers direct-connected to our Corliss engines form a particularly efficient and economical unit for large smelting plants.

Plate No. 2756



IMPROVED QUICK-OPENING BLAST VALVES

The higher blast pressure, which it has been found advantageous to use in the smelting of the more valuable metals, has created a demand for a stronger and tighter blast pipe valve than those used heretofore. To meet this demand the valve herein illustrated has been designed and brought out. It will be seen that the sides of the body or shell are well ribbed to prevent any springing apart when the blast pressure is on. The disc or gate is easily operated by means of an accurately cut steel rack and pinion. The seats and discs are carefully planed, making close joints.

This valve, when open, presents a full and unobstructed air passage. It is simple in construction, as light in weight and as short in length as it can consistently be made, practical in operation, and much to be preferred over other styles of valves now in use. We can furnish these valves for blast pipe of the following diameters: 14-inch, 16-inch 18-inch, 20-inch, 24-inch 27-inch, 30-inch, 36-inch, 42-inch and 48-inch.

Allis-Chalmers Manufacturing Company's

PRINCIPAL PRODUCTS

AGRICULTURAL MACHINERY

- Farm Tractors

AIR BRAKES

AIR COMPRESSORS

- Steam Driven
- Belt Driven
- Electrically Driven, Portable
- Electrically Driven, Stationary
- Hydraulic Driven

CEMENT MACHINERY

- Ball Mills
- Ball Tube Mills
- Balls, Forged
- Compeb Mills
- Crushing Rolls
- Elevators
- Feeders
- Gyratory Breakers
- Hoists
- Mixing Pans
- Perforated Metals
- Revolving Screens
- Rotary Coolers and Dryers
- Rotary Kilns
- Tube Mills
- Tube Mill Linings
- Tube Mill Pebbles

COAL MINING MACHINERY

- Barney Cars
- Crushing Rolls
- Hoisting Cages
- Revolving Screens
- Shaking Screens

CONDENSERS

- Barometric
- Jet
- Surface

CRUSHING MACHINERY

- Ballast Plants
- Crushing Rolls
- Dumping Skips
- Elevators
- Gyratory Breakers
- Jaw Crushers
- Macadam Plants
- Perforated Metals
- Portable Crushing Plants
- Revolving Screens
- Quarry Cars

ENGINES

- Corliss Engines
- Gas Engines
- Diesel Oil Engines
- Blowing Engines
- Rolling Mill Engines

FORGINGS

PERFORATED METALS

FLOUR MILL MACHINERY

- Aspirators
- Bolters, Universal
- Bolting Cloth
- Bolting Cloth Cleaners
- Bran and Shorts, Dusters
- Bran Packers
- Conveyors, Spiral
- Corn Mills
- Fans
- Feed Mills
- Feed Screens
- Flour Dressers
- Flaking Machines
- Flour Feeders and Mixers
- Flour Packers
- Granulators
- Purifiers
- Reels
- Rolls
- Roller Mills
- Rolling Screens
- Scalpers

HOISTS

- Electric Driven
- Steam Driven

HYDRAULIC MACHINERY

- Francis Turbines
- Impulse Wheels
- Oil Pressure Governors
- Pressure Regulators
- Accessories

MANGANESE BRONZE CASTINGS

MINING MACHINERY

- Amalgam Appliances
- Ball Granulators
- Chilian Mills
- Concentrating Plants
- Conveyors
- Copper Converting Plants
- Cyanide Plants
- Elevators
- Gold and Silver Mills
- Gyratory Breakers
- Huntington Mills
- Jaw Crushers
- Jigs
- Lead Refining Plants
- Mine Ventilating Machinery
- Mortar Mills
- Ore Buckets
- Ore Feeders
- Prospecting Mills
- Roasting Furnaces
- Sampling Plants
- Skips
- Smelting Machinery
- Stamps, Atmospheric
- Stamps, Gravity
- Stamps, Steam
- Tube Mills, Wet and Dry
- Vanners

POWER TRANSMISSION MACHINERY

- Belt Tighteners
- Boxes
- Couplings
- Gears
- Hangers
- Pulleys
- Rope Sheaves
- Shafting

PUMPING MACHINERY

- Centrifugal Pumps
- Fire Service Pumps
- Geared Pumps
- "High Duty" Pumping Engines
- Hydraulic Transmission Pumps
- Screw Pumps

ROLLING MILL MACHINERY

SAW MILL MACHINERY

- Band Mills, Double Cutting
- Band Mills, Single Cutting
- Band Mills, Telescopic
- Band Re-saws, Horizontal
- Band Re-saws, Vertical
- Board Lifters, Steam
- Cant Flippers, Steam
- Canting Machine, Overhead
- Carriages
- Circular Saw Mills
- Conveying Machinery
- Cutting Off Saws, Steam Feed
- Edgers
- Edging Grinders
- Feeds, Steam, Direct Acting
- Feeds, Steam, Twin Engine
- Filing Room Tools
- Lath Mills and Bolters
- Live Rolls and Drives
- Log Chains
- Log Jacks
- Log Loaders
- Log Turners
- Niggers, Steam
- Set Works
- Slashers
- Steam Feed Valves
- Stock Lifters, Steam
- Transfers
- Trimmers

SUGAR MACHINERY

TIMBER TREATING AND PRESERVING MACHINERY

TURBINES—STEAM

TURBINES—WATER

ELECTRICAL APPARATUS

ALTERNATING CURRENT GENERATORS AND MOTORS

- Belted Type Generators
- Engine Type Generators
- Fly-wheel Type Generators
- Turbo Generators
- Water-wheel Type Generators
- Synchronous Frequency Changers
- Induction Motor Frequency Changers
- Synchronous Motor-Generator Sets
- Induction Motor-Generator Sets
- Synchronous Motors
- Synchronous Condensers
- Induction Motors
- Transformers
- Rotary Converters

DIRECT CURRENT GENERATORS AND MOTORS

- Belted Type Generators
- Engine Type Generators
- Small Bipolar and Multipolar Motors and Generators
- Electric Railway Equipments, Motors, Controllers, etc.
- Multiple Voltage Balancing Sets
- Multiple Voltage Variable Speed Equipments

SWITCHBOARDS FOR DIRECT CURRENT AND ALTERNATING CURRENT

Allis-Chalmers Manufacturing Company

General Offices, - - Milwaukee, Wisconsin

DISTRICT OFFICES

Atlanta, Ga., 1104-1106 Healey Bldg.
Birmingham, Ala., 1010-1012 Brown-Marx Bldg.
Boston, Mass., 723-724 State Mutual Bldg.
Buffalo, N. Y., 574-576 Ellicott Square Bldg.
Charlotte, N. C., 212 Chamber of Commerce Bldg.
Chicago, Ill., 2026-2031 Peoples Gas Bldg.
Cincinnati, O., 1720 First National Bank Bldg.
Cleveland, O., 1119-1121 Schofield Bldg.
Dallas, Texas, 510 Sumpter Bldg.
Denver, Colo., 316 Foster Bldg.
Detroit, Mich., 1828-1829 Ford Bldg.
Duluth, Minn., 709 Alworth Bldg.
Kansas City, Mo., 1410-1412 Waldheim Bldg.
Los Angeles, Cal., 623-625 Title Insurance Bldg.
Milwaukee, Wis., West Allis Works.
Minneapolis, Minn., 707-711 Metropolitan Life Ins. Bldg.
New Orleans, La., 719-723 Maison Blanche Bldg.
New York, N. Y., 50 Church Street.
Philadelphia, Pa., 806-810 Franklin Trust Bldg.
Pittsburgh, Pa., 1207-1210 Park Bldg.
Portland, Ore., 604-606 Lumbermen's Bldg.
St. Louis, Mo., 2188-2189 Railway Exchange Bldg.
Salt Lake City, Utah, 608-610 Kearns Bldg.
San Francisco, Cal., 741-751 Rialto Bldg.
Seattle, Wash., 115 Jackson Street.
Toledo, O., 819 Ohio Bldg.
Wilkes-Barre, Pa., 904 Coal Exchange Bldg.

FARM TRACTOR DISTRICT OFFICES

Allis-Chalmers Mfg. Co., 213-215 N. Lamar St., Dallas, Texas.
Allis-Chalmers Mfg. Co., 1113 Farnam St., Omaha, Nebraska.
Allis-Chalmers Mfg. Co., 1019 West Broadway, Louisville, Kentucky.
Allis-Chalmers Mfg. Co., 422 Washington Ave., N., Minneapolis, Minn.

FOREIGN DISTRICT OFFICES

London, England, 728 Salisbury House, London Wall, E. C. 2.
Paris, France, 3 Rue Taitbout.
Rio de Janeiro, Brazil, Caixa 220.
Santiago, Chile, Calle Bandera 261, Casilla 2653.

CANADIAN REPRESENTATIVES

Canadian Allis-Chalmers, Limited:

FOREIGN SALES AGENCIES

French Indo China	Robertson-Cole Co., Singer Bldg., New York
Hankow, China	American Trading Company
Havana, Cuba	Thrall Electric Company
Honolulu, Hawaii	Honolulu Iron Works
Ipoh, Federated Malay States	Robertson-Cole Co., Singer Bldg., New York
Johannesburg, South Africa	Herbert Ainsworth
Kobe, Japan	American Trading Company
Lisbon, Portugal	Monteiro Gomes, Limitada
Madrid, Spain,	Gumersindo Garcia
Manila, P. I.	Honolulu Iron Works
Pekin, China	American Trading Company
Perth, West Australia	Frank R. Perrot
Porto Rico	Aboy & M. Hernondez Co., Bowling Green Bldg., New York, N. Y.
Santo Domingo and Haiti	Aboy & M. Hernondez Co., Bowling Green Bldg., New York, N. Y.
Shanghai, China	American Trading Company
Siam	Robertson-Cole Co., Singer Bldg., New York
Sydney, New South Wales, Australia	Frank R. Perrot
Sydney, New South Wales, Australia	Standard-Waygood-Hercules, Ltd.
Turin, Italy	Mario Axerio
Yokohama, Japan	American Trading Company